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Steven Ng

PACIFIC GAS AND ELECTRIC COMPANY

2014 ENERGY STORAGE PROCUREMENT APPLICATION

PREPARED TESTIMONY

PACIFIC GAS AND ELECTRIC COMPANY
2014 ENERGY STORAGE PROCUREMENT APPLICATION
PREPARED TESTIMONY

TABLE OF CONTENTS

Chapter	Title	Witness
1	OVERVIEW AND POLICY	Garrett P. Jeung
2	REPORT ON EXISTING AND ELIGIBLE STORAGE RESOURCES	Garrett P. Jeung
Attachment A	STORAGE RESOURCES PROCURED TO DATE IN ALL COMMISSION PROCEEDINGS	Garrett P. Jeung
3	INTENDED PROCUREMENT OF ENERGY STORAGE RESOURCES	Garrett P. Jeung
4	OPERATIONAL REQUIREMENTS FOR ENERGY STORAGE RESOURCES	Anna L. Foglesong Steven Ng
5	EVALUATION METHODOLOGY	Jan Grygier
Attachment A	CONSISTENT EVALUATION PROTOCOL SPREADSHEET	Jan Grygier
6	RECOVERY OF ENERGY STORAGE COSTS	Donna L. Barry
Appendix A	STATEMENTS OF QUALIFICATIONS	Donna L. Barry Anna L. Foglesong Jan Grygier Garrett P. Jeung Steven Ng

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 1

OVERVIEW AND POLICY

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 1
OVERVIEW AND POLICY

TABLE OF CONTENTS

A. Introduction 1-1

B. Description of the CPUC's Energy Storage Program 1-1

C. Overview of PG&E's 2014 Energy Storage Procurement Application 1-2

D. 2014 Energy Storage Procurement Policies 1-5

1. Overarching Policy 1-5

E. Conclusion 1-6

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 1
OVERVIEW AND POLICY

A. Introduction

In accordance with the Decision Adopting Energy Storage Procurement Framework and Design Program (D.13-10-040, the Decision) issued on October 17, 2013 in Energy Storage Rulemaking 10-12-007, Pacific Gas and Electric Company (PG&E) is submitting its 2014 Energy Storage Procurement Application (Application) and supporting prepared testimony for California Public Utilities Commission (CPUC or Commission) approval. The Decision implements the Energy Storage Procurement Program (the Storage Program), which requires PG&E to procure viable and cost-effective energy storage resources. This chapter provides a description of the Storage Program, an overview of PG&E's Procurement Application and supporting testimony, and PG&E's policy and strategy for implementing the Energy Storage Program during the 2014-2015 procurement cycle. In this Application, PG&E outlines its proposed procurement plan, sets forth a proposal for eligibility and evaluation criteria, describes avenues for utility ownership of storage, and describes cost recovery mechanisms for storage projects.

B. Description of the CPUC's Energy Storage Program

The Commission's stated objectives for the Storage Program, consistent with Assembly Bill 2514, is for energy storage resources to accomplish three purposes:

1) The optimization of the grid, including peak reduction, contribution to reliability needs, or deferment of transmission and distribution (T&D) upgrade investments.
2) The integration of renewable energy.
3) The reduction of greenhouse gas (GHG) emissions to 80 percent below 1990 levels by 2050, per California goals.

The Storage Program requires PG&E to procure 580 megawatts (MW) through a series of biennial solicitation cycles, beginning in 2014 and concluding in 2020. The MW targets are differentiated by three points of interconnection:

transmission, distribution, and behind-the-meter or "customer." To satisfy the procurement targets, a storage resource must be operational no later than 2024.

For this initial solicitation cycle, PG&E must issue a Request for Offer (RFO) no later than December 1, 2014 to meet an aggregate target of 90 MW to be procured across the three points of interconnection: 50 MW of transmission-connected energy storage, 30 MW of distribution-connected energy storage, and 10 MW of customer-connected energy storage. PG&E may shift up to 80 percent of the MW targets between the T&D targets, but no MW amount may be reallocated from the customer target. If the RFO results in an insufficient amount of viable and cost-effective energy storage bids, PG&E may defer up to 80 percent of this solicitation cycle procurement targets to a future solicitation year. In the event of over-procurement, the amount of over-procured storage resources may be applied to future solicitation targets.

C. Overview of PG&E's 2014 Energy Storage Procurement Application

As required by the Decision, PG&E is submitting its procurement Application for Commission approval prior to the issuance of the Energy Storage RFO. PG&E intends to issue its 2014 Energy Storage RFO on December 1, 2014. It will hold two informational events—an Energy Storage RFO Participant's Conference on December 18, 2014, and an Offer Form Webinar on January 14, 2015. A CPUC-approved Independent Evaluator (IE) will oversee the RFO process. Offers must be received by PG&E by February 27, 2015. PG&E will notify selected Participants of their offers' eligibility for shortlisting on June 30, 2015. Each executed agreement is contingent upon the issuance of all regulatory approvals needed for PG&E to recover its costs under the agreement in rates. Executed agreements will be submitted for CPUC review no later than December 1, 2015. Prior to requesting approval, for which PG&E recommends the Tier 3 advice letter process, PG&E will consult with its Procurement Review Group and the IE. The Commission will consider their opinions when it determines the reasonableness of the agreement for inclusion in PG&E's rates.

The prepared testimony supports PG&E's Application and its appendices and is incorporated into the Application by reference in accordance with Commission Rule 1.7.

Following this overview, the Testimony contains these chapters:

- Chapter 2 contains a discussion of existing and eligible resources. It also outlines PG&E's offsets to apply to this year's and future years' procurement targets.
- Chapter 3 presents descriptions of the intended storage resources PG&E will procure. It also contains the potential procurement avenues permitted by the Energy Storage Program and the ownership options PG&E may pursue.
- Chapter 4 contains a discussion of the operational requirements for an energy storage resource as defined by the products or uses that a resource may offer. The products and uses PG&E will be seeking will further at least one of the three guiding principles of the Storage Program.
- Chapter 5 provides detail on the evaluation methodology PG&E will use to select energy storage projects. Evaluation will be based on the full range of benefits and costs that storage resources can provide. This chapter also includes the Consistent Evaluation Protocol, which was developed in conjunction with the other investor-owned utilities (IOU) and Energy Division, and is to be used for reporting and benchmarking purposes only.
- Chapter 6 presents the rate mechanisms PG&E will use to recover the costs of energy storage projects procured. Cost recovery will be dependent on point of interconnection, function, and ownership of energy storage projects.

  In addition, the Application contains the following appendices:
  - Appendix A, "Rules and Statutes"
  - Appendix B, "2014 Energy Storage Request for Offers Solicitation Protocol"

The Commission has identified key issues in the implementation of the Storage Framework and requires IOUs to address these issues in their biennial applications. These matters are specified in Appendix A, Section 3.d). Table 1-1 describes the issues and provides a roadmap to where they are addressed in PG&E's 2014 Application:

TABLE 1-1
PACIFIC GAS AND ELECTRIC COMPANY
REQUIREMENTS FOR PROCUREMENT APPLICATION

Requirements for Procurement Application	
Storage Framework Component	**Location Within PG&E's 2014 Energy Storage Plan**
An updated, adjusted table with estimates for biennial procurement targets for each storage grid domain from current year to 2020;(a)	Application, Section II.X; Testimony Chapter 2
Reference to (1) needs study by the California Independent System Operator for the IOU's system, local, and flexible needs, if available, or (2) upgrade needs identified in the IOU's transmission or distribution planning studies;(b)	Application, Section II.B
A list of all applicable rules and statutes impacting the procurement plan;(c)	Application, Appendix A "Rules and Statutes"
An explanation of the type of storage resources and the associated MW quantities the IOU intends to procure, categorized by grid domains and use cases;(d)	Application, Section II.C; Testimony Chapter 3
A detailed description of how the IOU intends to procure resources specifying the structure of any RFO or alternative procurement processes and related timelines;(e)	Application, Section II.E Application, Appendix B "2014 Energy Storage Request for Offers Solicitation Protocol"
Operational requirements, to be applied either to all projects or separately with respect to transmission, distribution, and customer-sited storage.(f)	Application, Section II.D; Testimony Chapter 4
A proposed methodology for an analysis that evaluates bids on cost and fit submitted in a solicitation.(g)	Application, Section II.F; Testimony Chapter 5
Proposed storage equipment/power/services purchase agreements for successful bids involving third party-owned or –aggregated projects.(h)	Application, Appendix B – Appendix G1 "Energy Storage Agreement" Application, Appendix B – Appendix G2 "RPS Power Purchase Agreement" Application, Appendix B – Appendix G3 "RA Capacity Confirmation for Energy Storage" Application, Appendix B – Appendix G4, "Engineering, Procurement, and Construction Term Sheet for Utility Developed Energy Storage Projects" Application, Appendix B – Appendix G5 "Purchase and Sale Agreement Term Sheet" Application, Appendix B – Appendix G6 "Purchase and Sale Agreement Term Sheet for Transmission and Distribution Deferral Projects"
A report on all storage resources procured to date in all Commission proceedings.(i)	Application Section II.A; Testimony Chapter 2
Request for cost-recovery authorization.(j)	Application Section II.G; Testimony Chapter 6

(a) Energy Storage Decision, Storage Framework p. 7.
(b) *Ibid.*, p. 8.
(c) *Id.*
(d) *Id.*
(e) *Id.*
(f) *Id.*
(g) *Ibid.*, p. 9.
(h) *Id.*
(i) *Id.*
(j) *Ibid.*, p. 10.

D. 2014 Energy Storage Procurement Policies

1. Overarching Policy

During the 2014-2015 biennial energy storage procurement cycle, PG&E intends to procure energy storage resources that will be operational by the 2024 deadline, based upon attributes that can be associated with the Commission's principles of energy storage, which are grid reliability, renewable energy resource integration, and GHG emission reductions. PG&E has identified products and uses for storage interconnected to the T&D connected grid and has mapped them to the Commission's guiding principles. PG&E expects any given storage project to be capable of providing multiple products and uses. The focus on energy storage products and uses is the basis for a technology-neutral evaluation process that should ensure consideration of all storage systems. This should also result in the most cost-effective procurement consistent with the Commission's intent. The operational requirements for a storage project will be dictated by the specific products and uses offered by the project and will vary by the project's function.

PG&E will acquire T&D connected storage primarily through its 2014 competitive solicitation for storage, but may use any of the following methods as well:

- Eligible Energy Storage projects that are developed under Commission-approved contracts arising from other Commission proceedings, such as the Long-Term Procurement Plan proceeding, the Renewable Portfolio Standard Program, and the Resource Adequacy proceeding.[1]
- Other CPUC-approved channels, such as the California Energy Commission's Public Interest Energy Research or the CPUC's Electric Program Investment Charge-funded projects, under certain conditions.[2]

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1 Storage Decision, Conclusion of Law (COL) 11 and page 33, "Projects Authorized in Other Commission Proceedings."

2 Storage Decision, COL 10 and page 33, "Projects Funded From Third Parties."

E. Conclusion

PG&E's request for authorization to procure energy storage complies with the Energy Storage Framework adopted by Decision 13-10-040. The Commission should therefore approve PG&E's 2014 Energy Storage Application.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 2

REPORT ON EXISTING AND ELIGIBLE STORAGE RESOURCES

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 2
REPORT ON EXISTING AND ELIGIBLE STORAGE RESOURCES

TABLE OF CONTENTS

A. Introduction 2-1

B. Eligible Storage Projects 2-1

1. Eligibility Criteria 2-1

2. Pre-Approved Storage Projects 2-2

C. Adjustment to PG&E's Targets Using Existing Storage Projects 2-3

D. Report on Existing Storage Resources 2-5

1. Transmission-Connected and Distribution-Connected Storage Resources 2-5

2. Storage Resources Connected Behind-the-Customer Meter 2-5

E. Offsets 2-6

1. Existing Energy Storage Projects 2-6

a. Self-Generation Incentive Program 2-6

b. Permanent Load Shifting 2-7

c. Rice Solar Thermal Storage 2-8

d. Dairy Biogas 2-8

e. Sodium Sulfur Battery Projects 2-9

f. Vehicle to Grid Program 2-9

F. Deferments 2-10

G. Excess or Shortfall Procurement 2-10

H. Shifting Between Transmission and Distribution Grid Domains 2-10

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 2
REPORT ON EXISTING AND ELIGIBLE STORAGE RESOURCES

A. Introduction

The purpose of this chapter is to provide a report on all the existing and eligible storage resources Pacific Gas and Electric Company (PG&E) has procured to date and to demonstrate how the procured megawatts (MW) will be applied to current and future solicitation cycle procurement targets.[1] PG&E has provided an updated table with estimates for biennial energy storage procurement targets (Targets) for each storage grid domain from the current year to 2020, adjusted for offsets, deferrals, excess procurement, and planned shifting of MW between the transmission and distribution grid domains, as shown in Table 2-1, below.[2] PG&E's progress toward fulfillment of its current targets, by grid domain, is shown in Table 2-2, below.

B. Eligible Storage Projects

The Storage Decision established requirements for a storage resource to count against an investor-owned utility's (IOU) Targets. It pre-approved certain projects that PG&E has already procured and programs that PG&E has already implemented, provided that they meet certain eligibility criteria.

1. Eligibility Criteria

To be an eligible storage project capable of counting against the procurement Targets, the project must satisfy the following conditions:

- It was installed and first became operational after January 1, 2010.
- The project demonstrates its ability to meet one or more of the Storage program's guiding principles: grid optimization, renewable integration, or reduction of greenhouse gas emissions.
- The project will be operational no later than the end of 2024.

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1 In this chapter, the term "storage resource" refers to an energy storage system as defined in Public Utilities Code (Pub. Util. Code) Section 2835. The term "eligible storage resource" refers to a project that has been procured but is not yet operational, and "existing storage resource" refers to an operational storage projects. The terms "resource" and "project" are used interchangeably.

2 Storage Decision Appendix A, pp. 7-8.

- For pumped hydro systems, it may not be larger than 50 MWs.

Furthermore, the storage project must fulfill the definition of energy storage as specified in Pub. Util. Code 2835(a),[3] which defines a storage resource as, among other things, a system that uses "…mechanical, chemical, or thermal processes to store energy generated from renewable resources for use at a later time."[4]

2. Pre-Approved Storage Projects

The Storage Decision identified specific projects and programs that are approved to offset PG&E's Targets, subject to a demonstration that the eligibility criteria have been met. These specific projects and programs are:

- PG&E's California Public Utilities Commission (CPUC or Commission)-approved Power Purchase Agreement (PPA) with Rice Solar,[5] a 150 MW solar thermal generation project paired with molten salt storage, connected at the transmission grid domain. The guaranteed commercial operation date of this project is December 1, 2015;[6] it has not yet achieved commercial operation.
- The Vaca-Dixon Battery Project and Yerba Buena Battery Project, two pilot projects with a combined 6 MW capacity connected at the distribution domain. These projects are operational and are contributing to PG&E's knowledge of how to manage storage for grid reliability and market participation.[7]
- Installations supported by Commission-approved incentive payments through the Self-Generation Incentive Program (SGIP) and Permanent Load Shifting (PLS) program. SGIP provides financial incentives for the installation of new qualifying technologies, including Advanced Energy Storage (AES), that meet all or a portion of the electric energy needs of a facility. PLS reduces the demand for generation by resources at peak

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3 D.13-10-040, Appendix A, p. 5.

4 Pub. Util. Code 2835(a)(4)(C).

5 D.13-10-040, p. 28.

6 PG&E Advice Letter 3989-E, Commission Resolution E-4545, effective January 24, 2013.

7 D.13-10-040, p. 32.

times. Currently, PG&E has 3.5 MW of capacity installed behind customers' meters through the SGIP.

In total, PG&E's storage resources approved to offset the procurement targets in 2014 include: A potential 150 MW in the transmission grid domain, an eligible 6 MW in the distribution grid domain, and an eligible 3.5 MW in the behind-the-customer's meter grid domain.

C. Adjustment to PG&E's Targets Using Existing Storage Projects

For the 2014 solicitation cycle, PG&E has a total procurement target of 90 MWs across all three grid domains. For the first cycle, PG&E will count only operational storage against its current procurement period's Target and reserve the remainder of its existing energy storage to apply to future procurement cycle targets.

In addition to the pre-approved resources, PG&E has identified three existing PPAs totaling 2.52 MWs of capacity connected at the distribution level that burn dairy biogas that should count as existing energy storage.[8] The use of biogas to generate electricity relies on the storage of energy from biomass, which is a renewable resource, in the chemical form of biogas. The dairy biogas projects became operational after January 1, 2010, and are thus eligible to offset PG&E's energy storage target.

Because this is PG&E's first energy storage plan, there are no deferrals to report. The results of the 2014 Storage Request for Offers (RFO) will not be available until early 2015, so it is premature to reallocate any MWs between the transmission and distribution MW target grid domains. PG&E presents its adopted 2014-2020 Storage Program Targets as adjusted by its existing storage in the following pro-forma summary, Table 2-1, "PG&E's Forecast of Eligible Storage Offsets, 2014-2016," and PG&E's progress toward fulfillment of its current targets, by grid domain, in Table 2-2, "PG&E's Fulfillment of 2014 Storage Targets by Point of Interconnection," below.

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8 Auto Business Energy Coalition (ABEC) Bidart – Old River, 1.84 MW and ABEC Bidart – Stockdale, .6 MW, approved through PG&E Advice Letter 4193-E, effective June 27, 2013, and Blake's Landing Farm, .08 MW through an Assembly Bill 1969 feed-in tariff PPA.

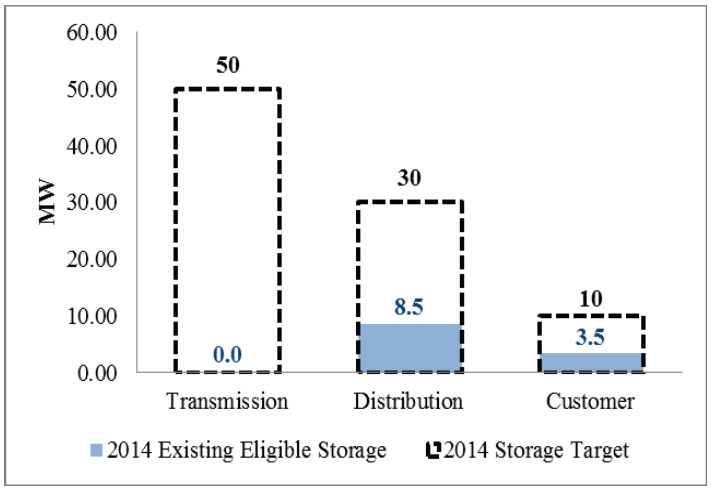
TABLE 2-1
PACIFIC GAS AND ELECTRIC COMPANY
PG&E'S FORECAST OF ELIGIBLE STORAGE OFFSETS
(2014-2020)

Line No.	(MW)	2014 CPUC-Set Targets	2014 Existing(a)	2014 To Be Procured	2016 CPUC-Set Targets	2016 Existing	2016 To Be Procured	2018 CPUC-Set Targets	2018 Existing	2018 To Be Procured	2020 CPUC-Set Targets	2020 Existing	2020 To Be Procured
1	Transmission	50.0	0.0	50.0	65.0	38.0	27.0	85.0	49.0	36.0	110.0	63.0	47.0
2	Distribution	30.0	8.5	21.5	40.0	–	40.0	50.0	–	50.0	65.0	–	65.0
3	Customer	10.0	3.5(b)	6.5	15.0	–	15.0	25.0	–	25.0	35.0	–	35.0
4	Total	90.0	12.0	78.0	120.0	38.0	82.0	160.0	49.0	111.0	210.0	63.0	147.0

(a) PG&E's 2014 existing storage forecasted here does not include the Rice Solar project.
(b) Based on PG&E's Rule 21 Interconnection Data Base.

TABLE 2-2
PACIFIC GAS AND ELECTRIC COMPANY
PG&E'S FULFILLMENT OF 2014 STORAGE TARGETS BY POINT OF INTERCONNECTION

Line No.	(MW)	2014 Existing Eligible Storage	2014 Total Storage Target
1	Transmission	–	50.0
2	Distribution	8.5	30.0
3	Customer	3.5	10.0
4	Total	12.0	90.0



D. Report on Existing Storage Resources

1. Transmission-Connected and Distribution-Connected Storage Resources

PG&E has compiled a report containing all of its transmission-connected and distribution-connected storage resources to date, as described by the type of storage technology, the capacity of the projects, the location, the proceedings it was procured through, the procurement mechanism, grid domain, status of the project, estimated online date, expected operational life, primary and secondary applications, the technology manufacturer, and the project owner and operator. This report is provided in a table entitled "Storage Resources Procured to Date in All Commission Proceedings," which is appended as Attachment 2A, to this testimony.

2. Storage Resources Connected Behind-the-Customer Meter

PG&E reports the amount of storage connected behind the customer meter based on the information available from the reporting mechanisms of its SGIP database, the Rule 21 database, or the PLS database. The databases and verification systems already in place for the incentive programs are robust. For example, the SGIP program tracks the kilowatts (kW) of storage incentives from the time of incentive reservation until final installation. PG&E also has a robust Rule 21 distribution system interconnection database that tracks the number of kW per interconnection of AES projects, as well as customer-side storage projects undertaken without any incentive payments at all by the PG&E will use its distribution Interconnection data base to track customer-connected energy storage installations. Finally, PG&E's PLS program tracks all incentive reservations and final installations of Thermal Energy Storage (TES) within the PLS database.

PG&E has summarized its proposal for reporting its customer-side energy storage projects on a bi-annual basis in Table 2-1, above.

E. Offsets

1. Existing Energy Storage Projects

The Storage Decision determined that storage projects identified in the Proposed Plan[9] should be counted toward the IOUs' procurement targets provided that, (1) they demonstrate the ability to meet one or more of the following purposes: grid optimization, integration of renewable energy, or reduction of greenhouse gas (GHG) emissions; (2) the project is under contract or was installed after January 1, 2010, and (3) the project is operational no later than the end of 2024.

PG&E's energy storage projects under contract are specified in detail in Attachment 2A, "Storage Resources Procured to Date in All Commission Proceedings," which is located at the end of this chapter. PG&E describes how the following energy storage programs, which were pre-approved by the Proposed Plan, satisfy the criteria for counting toward PG&E's storage target.

a. Self-Generation Incentive Program

SGIP provides incentives to support existing, new, and emerging distributed energy resources, including incentives for qualifying "AES" systems installed on the customer's side of the utility meter. Within SGIP, AES systems are defined as technologies that convert electricity into another form of energy that can be readily stored and then converted back to electricity at another time. There are various types of customer-side storage technologies eligible for SGIP incentives, but the large majority of proposed projects to date consist of Lithium Ion battery technology. As of 2014, SGIP offers incentives of $1.62 per watt for up to 60 percent of the customer's approved project costs for up to of 3 MW of supported capacity per site and no more than $5 million per project.

SGIP program requirements are aligned with the principles of energy storage. AES systems coupled with wind generation must have the ability to handle hundreds of partial discharge cycles each day and

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9 "Proposed Plan" is the straw proposal presented in the June 10, 2013 Assigned Commissioner's Ruling in the rulemaking underlying the Storage Decision, Rulemaking 10-12-007. Storage Decision, p. 6.

thus promote the integration of renewable energy. Energy storage systems, whether coupled with a generator or stand-alone, need to maintain "round trip efficiencies" equal to or greater than 63.5 percent on an annual basis in order to be eligible under the SGIP program.[10] This serves the Commission's principle that energy storage should reduce GHG emissions. As of September 2011, the Commission determined that eligibility for SGIP shall be based on GHG emissions reductions.[11]

To date, SGIP has over 10 MW of storage projects that have applied for incentives and PG&E expects these projects to be on-line by 2024. SGIP has roughly 3.5 MW of installed customer-side storage. This incentive program is approved for administration through 2015.

PG&E can count SGIP projects towards the customer connected target. Currently, PG&E has installed ~3.5 MW of SGIP projects. However, PG&E has an additional 66 kW of customer-side of the meter energy storage projects that did not seek SGIP funding. All customer connected storage projects should count towards the storage target since there are a variety of reasons why a customer may decide not to apply for SGIP funds.

b. Permanent Load Shifting

PLS resources shift electricity use from on-peak to off-peak periods on a daily basis and often involve storing energy produced during off-peak hours for cooling use during peak periods. PLS provides an incentive to encourage cooling TES technology on the customers' side of the utility meter. Using TES, such as chilled water storage or ice-on-coil technologies, customers can redistribute energy use for cooling from on-peak to off-peak hours and save on their energy bills. At the same time, TES reduces demand at peak periods, which generally reduces the use of resources with the highest heat rates and avoids incremental GHG emissions. PG&E offers a technology incentive of $0.875 per watt shifted, up to 50 percent of project cost, and

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10 Round trip efficiency is defined as the ratio of the alternating current (AC) electric energy discharged to the AC electric energy needed to charge the AES system. 2013 Self-Generation Incentive Program Handbook, September 1, 2013, p. 46.

11 D.11-09-015.

caps the incentive amount at $1.5 million per customer. PLS-TES is a statewide incentive program for which PG&E began accepting applications in October 2013. To date, no projects have been installed.

c. Rice Solar Thermal Storage

PG&E signed a PPA for 150 MW generated by a solar thermal project with molten salt storage as part of its Renewables Portfolio Standard program. This project is currently under development. PG&E anticipates that this project may have as much as eight hours of full storage capability, or up to 1,200 megawatt-hours per day. Such storage could be beneficial for integrating the solar resource, by storing energy instead of using it to deliver electricity during periods of low unmet need, and providing for a more consistent delivery profile for intermittent generation. PG&E would count this project beginning with the 2016 biennial procurement cycle by allocating its 150 MW of capacity over the three remaining procurement cycles on an equal percentage basis of the Transmission-connected targets, as shown in Table 2-1 above.

d. Dairy Biogas

PG&E currently has under contract three Dairy Biogas projects totaling 2.52 MW connected at the distribution level. PG&E requests the Commission to determine that electric generation using biogas technology is eligible to be counted toward the procurement Target. PG&E does not propose to procure such resources through the 2014 RFO, but only through other existing mechanisms.

Section 2835(a) defines “energy storage system” as “commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy.” An energy storage system must also possess at least one of the following storage characteristics: (1) use mechanical, chemical, or thermal processes to store energy that was generated at one time for use at a later time; (2) store thermal energy for direct use for heating or cooling at a later time in a manner that avoids the need to use electricity at that later time; (3) use mechanical, chemical, or thermal processes to store energy

generated from renewable resources for use at a later time; or (4) use mechanical, chemical, or thermal processes to store energy generated from mechanical process that would otherwise be wasted for delivery at a later time.

Dairy biogas systems rely on a chemical process to store energy from renewable biomass on-site for use at a later time. But for the biogas storage, the energy in the methane produced by decomposition of biomass would be wasted. Like thermal storage, the energy in biogas fuel contributes to the generation of electricity at a later time.[12] The Commission should confirm that electric generation using dairy biogas is eligible to count toward energy storage targets.

e. Sodium Sulfur Battery Projects

PG&E is currently conducting two pilot projects using sodium sulfur batteries from NGK. The first project is a 2 MW, 7-hour duration battery located at the Vaca-Dixon Substation. The second project is a 4 MW, 7-hour duration battery located on a distribution line at a customer location in San Jose. These projects are being used for grid reliability purposes and the integration of renewable resources. Each pilot project became operational in 2012 and 2013, respectively, and will count towards the storage target.[13] PG&E intends to continue expanding the pilot projects' ability to participate in wholesale markets and to test other end use functions.

f. Vehicle to Grid Program

PG&E has one Vehicle-Grid Integration pilot, known as the Demand Response Plug-In Electric Vehicle (DR PEV) Pilot. The goal of this pilot is to sign a procurement contract with one or more Electric Vehicle (EV) automakers for flexible MW in the future. The pilot will be unique. PG&E intends to list the California Independent System Operator (CAISO) products and the operational requirements to satisfy CAISO

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12 The Energy Storage Decision identifies the Commission-approved PPA between PG&E and Rice Solar for a solar thermal generation project paired with molten salt storage as eligible to count toward the Energy Storage Target. Energy Storage Decision, p. 28, citing also CPUC Resolution E-4545.

13 Energy Storage Decision, p. 32.

needs, for a counterparty to provide. The automaker will have flexibility to specify the product offered, the size of the resource offered, and the contract term. Thus, an automaker (seller) could offer to fulfill the contracted MW with smart charging vehicles, a vehicle-to-grid fleet of vehicles, or second-life batteries, or any combination of the proceeding options. All these options contribute to grid reliability, renewable integration, or GHG emission reductions; they assist with the integration of renewable energy by absorbing energy and thus mitigating over-generation, shifting energy, and reducing the intermittency of renewable resources. The Commission is considering the integration of Vehicle-to-grid resources in a separate proceeding.[14] To the extent that energy storage opportunities are authorized in the electric vehicle grid integration proceeding, PG&E will consider procuring such feasible cost effective measures toward its 2014-2015 Target.

F. Deferments

There is no previous procurement cycle from which PG&E could have deferred its procurement. Accordingly, there are no deferments to be added to PG&E's adopted 90 MW target, which is adjusted to 78 MW for this procurement cycle.

G. Excess or Shortfall Procurement

As stated above, there is no prior energy storage procurement cycle from which PG&E could have accrued excess or insufficient storage capacity relative to that procurement cycle target.

H. Shifting Between Transmission and Distribution Grid Domains

PG&E will make a determination on shifting between transmission and distribution in a future cycle.

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[14] Order Instituting Rulemaking 13-11-007 was issued on November 22, 2013 to adopt policies, guidelines and implementation strategies to facilitate utility participation in vehicle-grid integration. "We will … seek to establish rules that allow utilities, PEV drivers, and the grid to capture safely and reliably the benefits of PEV battery storage for the managed charging, and for providing demand response ancillary services to the grid and power markets." (R.13-11-007, p. 15.) The Commission intends to coordinate its ongoing proceedings that are developing storage-related rules to avoid duplicating efforts." (Id., p. 17.) To the extent that energy storage opportunities are authorized in the electric vehicle grid integration proceeding, PG&E will consider procuring such feasible cost effective measures toward its 2014-2015 Target.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 2

ATTACHMENT A

STORAGE RESOURCES PROCURED TO DATE IN ALL COMMISSION PROCEEDINGS

Pacific Gas and Electric Company
2014 Energy Storage Procurement Application
Chapter 2-Attachment A - Storage Resources Procured to Date in All Commission Proceedings

Project Name	Eligible Biennial Procurement Cycle	Online Date (GCOD or Actual)	Storage Technology	Inter-connection Level	Capacity (MW)	Energy Content (MWh)	Location (City)
Vaca-Dixon Battery Energy Storage System (BESS)	2014	Q4 2012	Sodium Sulfur Battery	Distribution	2.00	14	Vacaville
Yerba Buena Battery Energy Storage System (BESS)	2014	Q2 2013	Sodium Sulfur Battery	Distribution	4.00	28	San Jose
ABEC Bidart - Stockdale LLC	2014	4/6/2013	Dairy biogas	Distribution	0.60	1,400	Bakersfield
ABEC Bidart - Old River LLC	2014	2/28/2014	Dairy biogas	Distribution	1.84	13,000	Bakersfield
Blake's Landing Farm	2014	11/2/2010	Dairy biogas	Distribution	0.08	600	Marshall
Rice Solar Energy, LLC	2016-2020	6/1/2016	Solar Thermal - Molten Salt Storage	Transmission	150.00	1,200	Rice, CA

Pacific Gas and Electric Company
2014 Energy Storage Procurement Application
Chapter 2-Attachment A - Storage Resources Procured to Date in All Commission Proceedings

Project Name	Location (Zip Code)	Procurement Proceeding	Procurement Mechanism	Status of Project	Expected Operational Life (Years)	Primary Application of Project
Vaca-Dixon Battery Energy Storage System (BESS)	95688	PG&E PV Program D.10-04-052	Engineering, Procurement, and Construction (EPC) RFO	Operational, Commercial in CAISO Non-Generator Resources (NGR) markets	10-15 years	Grid optimization
Yerba Buena Battery Energy Storage System (BESS)	95135	PG&E PV Program D.10-04-052	EPC RFO	Operational, islanding functionality enabled, not yet commercial in CAISO markets	10-15 years	Grid optimization
ABEC Bidart - Stockdale LLC	96013	Bilateral RPS Negotiation Resolution E-4596	Bilateral RPS-eligible PPA	Operating	20	GHG emission reduction
ABEC Bidart - Old River LLC	95361	Bilateral RPS Negotiation Resolution E-4596	Bilateral RPS-eligible PPA	Test Energy Phase	20	GHG emission reduction
Blake's Landing Farm	96020	RPS D.07-07-027	AB 1969 Feed-In Tariff	Operating	20	GHG emission reduction
Rice Solar Energy, LLC	N/A	2009 RPS Solicitation Resolution E-4545	Bilateral RPS-eligible PPA	Under Development	25	Renewables Integration

Pacific Gas and Electric Company
2014 Energy Storage Procurement Application
Chapter 2-Attachment A - Storage Resources Procured to Date in All Commission Proceedings

Project Name	Secondary Application of Project	Technology Manufacturer	Project Owner	Project Operator
Vaca-Dixon Battery Energy Storage System (BESS)	Renewables Integration	N/A	N/A	N/A
Yerba Buena Battery Energy Storage System (BESS)	Renewables Integration	N/A	N/A	N/A
ABEC Bidart - Stockdale LLC	N/A	N/A	N/A	N/A
ABEC Bidart - Old River LLC	N/A	N/A	N/A	N/A
Blake's Landing Farm	N/A	N/A	N/A	N/A
Rice Solar Energy, LLC	GHG emission reduction	N/A	N/A	N/A

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 3

INTENDED PROCUREMENT OF ENERGY STORAGE RESOURCES

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 3
INTENDED PROCUREMENT OF ENERGY STORAGE RESOURCES

TABLE OF CONTENTS

A. Introduction 3-1

B. Procurement by Grid Domains 3-1

1. Transmission and Distribution Connected Storage Systems 3-1

2. Customer Connected Storage 3-3

C. Quantities 3-3

D. Technologies 3-4

E. Eligibility 3-5

1. Project Offers 3-5

2. Performance and Operational Requirements 3-5

3. Product Requirements 3-5

4. Electrical Interconnection 3-5

5. Third-Party Funding 3-6

6. Project Size 3-6

7. Location 3-6

8. Online Date 3-6

9. Additional Considerations 3-7

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 3
INTENDED PROCUREMENT OF ENERGY STORAGE RESOURCES

A. Introduction

The California Public Utilities Commission (CPUC or Commission) issued Decision 13-10-040 (the Storage Decision) on October 17, 2013. The Storage Decision requires that the Investor-Owned Utilities (IOU) 2014 Procurement Application include, "An explanation of the type of storage resources and the associated MW quantities the IOU intends to procure, categorized by grid domains and use cases."[1] At this time, Pacific Gas and Electric Company (PG&E) cannot reasonably provide specifics of the type and quantity of storage to fulfill the targets until evaluating the offers from the 2014 Request for Offers (RFO). PG&E intends to conduct solicitations and evaluations that focus on the performance attributes, or products, offered by the storage resource, rather than the technology employed to generate those attributes or products.

B. Procurement by Grid Domains

1. Transmission and Distribution Connected Storage Systems

The primary vehicle for the procurement of energy storage connected to the Transmission and Distribution (T&D) facilities of PG&E will be the competitive RFO.

PG&E will consider all forms of resource ownership, including utility-owned and third-party owned. Third-party and utility-owned energy storage proposals that are submitted in the RFO will compete on a head-to-head basis. The basic type of offer in the RFO is the Energy Storage Agreement (ESA), whereby a third-party offers a standalone energy storage resource to PG&E, with the project operating solely as a wholesale market resource and continuing as a third-party owned asset for the duration of the contract. A turnkey structure is also possible for energy storage projects used either for wholesale market purposes or as T&D assets. This application includes a *pro-forma* term sheet for turnkey storage projects that

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1 Storage Decision, Appendix A, p. 8.

would be used solely as a wholesale market resource. Since PG&E has not yet determined if there are locations where storage projects could be utilized as T&D assets, a *pro-forma* term sheet for turnkey storage projects to be utilized as T&D assets is not included in this application. However, should PG&E identify such opportunities, market participants will be provided with detailed term sheets with which to propose turnkey storage projects.

Based on previous expressions of interest received in response to its December 2012 Request for Information, PG&E anticipates numerous offers to serve the T&D domains that may be described generally as follows:

a) **Stand-alone T&D Connected Storage for market participation** – Energy storage that is controlled independently of other generation sources, is connected at the T&D system, and is capable of participating in the California Independent System Operator (CAISO) wholesale markets. Stand-alone storage accomplishes charging and discharging functions through market participation.[2]

b) **Storage attached to existing conventional generation** – Energy storage that is located on-site with an existing conventional resource and is used to enhance the on-site generator's performance, and/or participation in CAISO wholesale markets**.**

c) **Storage attached to a Renewable Portfolio Standard (RPS) resource** – Energy storage that is located on-site of a resource eligible to participate in the RPS Program and is used to enhance the on-site generator's performance and/or participation in CAISO wholesale markets**.**

d) **Storage based upon the needs of T&D Operations** – Energy storage that is providing transmission or distribution grid optimization benefits to improve reliability and/or defer PG&E identified T&D investments, and may be capable of participating in CAISO wholesale markets.

PG&E will require that all energy storage projects providing T&D grid optimization benefits be utility owned. This requirement is prudent and necessary to ensure system reliability and the effective operation of T&D

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2 This category of energy storage would be classified as a Non-Generator Resource, as defined by the CAISO tariff.

assets. The complete control of usage, maintenance, and replacement that comes with facility ownership, rather than relying on contractual obligations, is necessary to ensure continued operation and reliability.

The utility ownership of distribution assets is also necessary for compliance with Public Utilities Code (Pub. Util. Code) Section 399.2(a)(2), which specifies that "each electrical corporation shall continue to be responsible for operating its own electric distribution grid including, but not limited to, owning, controlling, operating, managing, maintaining, planning, engineering, designing, and constructing its own electric distribution grid, emergency response and restoration, service connections, service turn-ons and turn-offs, and service inquiries relating to the operation of its electric distribution grid, subject to the commission's authority."

Finally, PG&E may evaluate developing and owning energy storage facilities through the processes authorized[3] by the Energy Storage Decision.

2. Customer Connected Storage

Customer connected storage targets will be achieved through the CPUC proceedings including, but not limited to, the 2015-2017 demand response application, the distributed generation/California Solar Initiative rulemaking, and alternative-fueled vehicle rulemaking.[4] For the 2014 procurement cycle, PG&E will rely primarily on the Self-Generation Incentive Program (SGIP) and Permanent Load Shift (PLS) programs to fulfill its procurement targets. PG&E is confident that through these existing approved programs it can meet the first cycle target. Specifically, SGIP has been very successful in incentivizing customer connected storage projects and the current pipeline of SGIP reserved incentive applications indicate that PG&E will meet its 10 megawatt (MW) target for the 2014-2016 cycle.

C. Quantities

PG&E intends to procure the full amount of the CPUC *pro-forma* storage targets required for the 2014 procurement cycle. However, as stipulated in the

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3 Storage Decision, Appendix A, page 6, "An IOU proposing utility-owned storage in any grid domain, expect for projects that involve distribution reliability applications, shall pursue a competitive process consistent or comparable to the process described in D.07-12-052."

4 Storage Decision, p. 58.

Energy Storage Decision, PG&E may defer up to 80 percent of the transmission and distribution targets, based on the cost-effectiveness and operational viability of the offers received in the 2014 RFO.

D. Technologies

All "energy storage resources" as defined by Pub. Util. Code Section 2835(a), with the exception of pumped storage over 50 MW, are eligible to participate in the RFO, subject to locational and minimum size thresholds.[5] The Pub. Util. Code defines energy storage as commercially available technologies that meet the following definition:

Storage Process: It must meet at least one of the following characteristics: (1) use mechanical, chemical, or thermal processes to store energy that was generated at one time for use at a later time; (2) store thermal energy for direct use for heating or cooling at a later time in a manner that avoids the need to use electricity at that later time; (3) use mechanical, chemical, or thermal processes to store energy generated from renewable resources for use at a later time; or (4) use mechanical, chemical, or thermal processes to store energy generated from mechanical process that would otherwise be wasted for delivery at a later time.

PG&E believes that bio-methane technologies count as energy storage and would count towards meeting the energy storage requirements. Biogas[6] is derived chemical process from naturally occurring fermentation of biodegradable material. Some of the sources of biogas include landfill gas emissions, wastewater digesters, and animal manure from dairies. Biogas is collected, stored, and can be converted into electricity and heat. In California, it is considered a source of renewable energy.

By definition, Biogas would qualify as a chemical process that stores energy from renewable resources for use at a later time. The Storage Decision allows the Rice Solar Thermal project to qualify as a storage resource. Rice Solar fits within the same definition of energy storage, where a thermal process is used to store energy from a renewable source.

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5 Storage Decision, Appendix A, p. 5, "3) b) Procurement Eligibility."

6 http://www.calstart.org/Libraries/Publications/Biomethane_from_Dairy_Waste_Full_Report.sflb.ashx.

E. Eligibility

1. Project Offers

To be eligible, an offer must propose a specific energy storage project with a specific technology, a project size in MW, and a specific location. The pricing of the offer must include all costs to develop, own and operate the project, including the costs to site, permit, interconnect, finance, construct, operate, maintain and overhaul the project as necessary. Where a third-party owned energy storage system has received funds from a local, state, or federal publicly funded program, the level and source of funding shall be identified and the full costs of the project, including publicly-funded costs, provided.

2. Performance and Operational Requirements

The Project must be connected to the CAISO grid and able to respond to electronic signals conveying dispatch instructions from the CAISO or PG&E and have a minimum of 15 minutes duration.

3. Product Requirements

As will be further provided in the applicable Procurement Agreement, for agreements with Energy Storage Facilities, each Participant must agree and be able to: (i) schedule and dedicate the contracted amount of electrical output or Product to PG&E, net of station use and electrical losses; and (ii) not to sell, deed, grant, convey, transmit, or otherwise provide any energy, capacity, ancillary services or any other related electricity product, including Green Attributes, or capacity attributes associated with the output to an entity other than PG&E.

4. Electrical Interconnection

For projects that are shortlisted and have not yet initiated an interconnection request, such process should be initiated at the first available time in conjunction with PG&E's and the CAISO's Generator Interconnection and Deliverability Allocation Procedures (GIDAP) process. At the time of execution, projects will be required to be in the interconnection queue.

5. Third-Party Funding

Energy storage projects receiving funding from third parties, such as Public Interest Energy Research and Electric Program Investment Charge, may count toward procurement targets provided these energy storage projects meet the requirements listed above. Funding from other third-party sources not listed must be disclosed.

6. Project Size

Through the 2014 Energy Storage RFO, PG&E seeks offers for energy storage projects that will participate in the wholesale market, and offers for projects that will be utilized as transmission or distribution assets, which are collectively referred to as "T&D Assets." Due to operational restrictions and administrative burden, offers for wholesale market resources will only be considered if they meet the following minimum size criteria: (1) resources connected at the distribution level must be at least 1 MW; and (2) resources connected at the transmission level must be at least 10 MW. At the transmission level, multiple Energy Storage facilities may aggregate their capacity in order to achieve the minimum project size, so long as the aggregate product is at least 10 MW, no single facility is less than 1 MW, the aggregate product has a single CAISO Resource ID, and the aggregate product is capable of being scheduled by the Buyer and dispatched by the CAISO or PG&E, as if they were one project, in accordance with the terms of the ESA. Size requirements for T&D Assets will be included in the specifications issued for any identified transmission or distribution upgrade deferral projects in the RFO issuance documents.

7. Location

PG&E believes that all qualifying energy storage projects should count towards the targets, regardless of their location, as long as they meet one of the CPUC's guiding principles for energy storage. Projects located in another state, provided they are directly connected to the CAISO, should count towards a utility's storage targets.

8. Online Date

All storage projects with online dates after January 1, 2010 will count towards the procurement targets, including projects that are constructed

alongside a generation project that was constructed prior to January 1, 2010. For example, if a developer is bidding a new storage facility that would be attached to an existing renewables facility that was operational prior to January 1, 2010, the storage facility is eligible because it would be coming on line after January 1, 2010. Projects should provide online dates that provide PG&E the assurances that the project will be online by or prior to the date set in the Storage Decision, which is the end of the year 2024, for PG&E to meet its targets.

9. Additional Considerations

Energy storage projects "procured," that is, those projects which have executed contracts with an IOU, pursuant to any other Commission authorization in other proceedings, may not be offered into this competitive solicitation. Projects that have been offered into any other Commission-authorized procurement framework, but have not yet executed a contract, may participate in PG&E's Energy Storage RFO if the project's other obligations are not violated. Projects that have been shortlisted in another PG&E RFO, and have posted a shortlist deposit in the other RFO, will still need to post a shortlist deposit for this Energy Storage RFO.

Projects authorized in other proceedings will count toward meeting the Storage Program Target if they meet the Storage Program requirements—the project demonstrates its ability to meet one or more of the following purposes: grid optimization, integration of renewable energy, or reduction of greenhouse gas emissions; the project is under contract or was installed after January 1, 2010; and the project is operational by no later than the end of 2024.[7]

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7 Storage Decision, p. 34.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 4

OPERATIONAL REQUIREMENTS FOR ENERGY STORAGE RESOURCES

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 4
OPERATIONAL REQUIREMENTS FOR ENERGY STORAGE RESOURCES

TABLE OF CONTENTS

A. Introduction 4-1

B. Mapping Commission's Guiding Principles to PG&E's Products and Uses 4-1

C. Operational Requirements for PG&E's Products and Uses 4-4

1. Generation / Market 4-5

2. Transmission and Distribution Reliability 4-5

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 4
OPERATIONAL REQUIREMENTS FOR ENERGY STORAGE RESOURCES

A. Introduction

As stated in Decision 13-10-040, the California Public Utilities Commission's (CPUC or Commission) energy storage procurement policy has three guiding principles: (1) The optimization of the grid, (2) The integration of renewable energy, and (3) The reduction of greenhouse gas emissions.[1] In Section B, PG&E identifies products and uses[2] for energy storage projects that it anticipates will meet the Commission's guiding principles for its energy storage procurement policy. In Section C, PG&E describes the operational requirements to be applied to storage projects providing these products and uses.

B. Mapping Commission's Guiding Principles to PG&E's Products and Uses

In Appendix A of Decision 13-10-040,[3] the Commission directed each Investor-Owned Utility to include in its energy storage application the operational requirements "to be applied either to all projects or separately with respect to transmission, distribution, and customer-sited storage" for services, products, and beneficial project attributes that an energy storage project can provide to satisfy the guiding principles of grid optimization, renewable energy integration and/or greenhouse gas emission reductions. PG&E classifies these services, products and beneficial project attributes more broadly as products and uses.

In Table 4-1, PG&E has identified products and uses for the transmission-connected and distribution-connected storage grid domains[4] and mapped them to specific guiding principles of the Commission's energy storage procurement policy. In Section C, the operational requirements for storage projects providing

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1 D.13-10-040, Section 4.1. Guiding Principles, pp. 9-10.

2 Table 1 of D.13-10-040, p. 14, identifies some "Use-Case Examples" for different storage grid domains and regulatory functions. Because PG&E does not want to pre-judge any particular "Use-Case," PG&E is using the terms products and uses, which are intended to be technology neutral.

3 Appendix A of D.13-10-040, Section 3)d), pp. 7-10.

4 Storage grid domains are listed in Table 1 of D.13-10-040, p. 14.

these products and uses that contribute to the Commission's guiding principles are described. Table 4-1 does not include products and uses for the behind-the-meter storage grid domain because operational requirements for customer-sited storage projects will be developed as part of each Commission proceeding that governs a customer storage program and/or pilot.

PG&E notes that energy storage remains an emerging technology and its experience with owning and operating such systems is limited. This mapping in Table 4-1 demonstrates an effort to transparently link anticipated energy storage products and uses to specific guiding principles, while fully acknowledging there may be other unanticipated products and uses that emerge in the future, which are not included in these tables. The energy storage products and uses identified in Table 4-1 are intended to be technology neutral. PG&E does not pre-judge any particular energy storage use-case[5] and instead focuses on identifying products and uses that support the Commission's guiding principles.

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5 Table 1 of D.13-10-040, p. 14, identifies some "Use-Case Examples" for different storage grid domains and regulatory functions.

TABLE 4-1
PACIFIC GAS AND ELECTRIC COMPANY
MAPPING COMMISSION'S GUIDING PRINCIPLES TO PG&E'S PRODUCTS AND USES FOR THE TRANSMISSION
DISTRIBUTION-CONNECTED STORAGE GRID DOMAINS

Line No.	Guiding Principles	PG&E's Products and Uses	Storage Grid Domain	Regulatory Functio
1	Optimization of the grid	Blackstart capability(b)	Transmission	Generation / Market
2		System and local Resource Adequacy(c)	Transmission + Distribution	Generation / Market
3		Frequency response (inertia)(d)	Transmission + Distribution	Transmission Reliability
4		T&D capacity upgrade deferral(e)	Transmission + Distribution	Transmission + Distribution
5		T&D reliability upgrade deferral(f)	Transmission + Distribution	Transmission + Distribution
6	Integration of renewable energy	Frequency Regulation(b)	Transmission + Distribution	Generation / Market
7		Spinning/Non-Spinning Reserves(b)	Transmission + Distribution	Generation / Market
8		Flexible Ramping Product(g)	Transmission + Distribution	Generation / Market
9		Over-generation and curtailment support(h)	Transmission + Distribution	Generation / Market
10		Energy shifting(i)	Transmission + Distribution	Generation / Market
11		Flexible Resource Adequacy(j)	Transmission + Distribution	Generation / Market
12		Reduces intermittency of renewable resource(k)	Transmission + Distribution	Generation / Market
13	Reduction of GHG emissions	Energy shifting(i)	Transmission + Distribution	Generation / Market
14		Over-generation and curtailment support(h)	Transmission + Distribution	Generation / Market
15		Improves efficiency for fossil generation(l)	Transmission + Distribution	Generation / Market

(a) Cross-reference with Storage 'End Use' in Figure 2 of Energy Storage Framework Staff Proposal (http://www.cpuc.ca.gov/NR/rdonlyres/46414F3248F5/0/EnergyStorage_FinalStaffProposal.dcx).

(b) See CAISO Tariff (https://www.caiso.com/Documents/ConformedTariff_Dec17_2013.pdf), Section 8.

(c) See the Commission's Resource Adequacy program (http://www.cpuc.ca.gov/PUC/energy/Procurement/RA/ra_history.htm) and the CAI http://www.caiso.com/planning/Pages/ReliabilityRequirements/Default.aspx).

(d) See proposed CAISO initiative (http://www.caiso.com/Documents/Draft2013StakeholderInitiativesCatalogRevisedJan28_2014.pdf) on F

(e) Refers to the ability of storage to defer a planned transmission or distribution capacity upgrade investment.

(f) Refers to the ability of storage to defer a planned transmission or distribution reliability upgrade investment.

(g) See CAISO initiative (http://www.caiso.com/informed/pages/stakeholderprocesses/flexiblerampingproduct.aspx) on Flexible Ramping Pr

(h) Refers to the ability of storage to charge during over-generation or negative price periods and discharge during non-binding periods.

(i) Refers to the ability of storage to charge during relatively lower priced off-peak periods and discharge during relatively higher priced pea

(j) See the Commission's current RA proceeding (Rulemaking 11-10-023) and the CAISO's FRAC-MOO initiative (http://www.caiso.com/informed/pages/stakeholderprocesses/flexibleresourceadequacycriteria-mustofferobligations.aspx).

(k) Refers to the ability of storage to firm the intermittency that a renewable resource delivers to the transmission and distribution system by renewable output and discharging during times of low renewable output.

(l) Refers to the ability of storage to lower the average GHG emissions rate the fleet of fossil-fires resources or of a single fossil-fired resou starts in the fleet or by reducing a particular unit's actual heat rate.

The selection of any given energy storage project to provide products and uses identified in Table 4-1 will be the end result of a thorough procurement process. It will begin with PG&E's evaluation of offers in its energy storage solicitation[6] and end with negotiating and ultimately converting some offers into contracts. While only a subset of products and uses described here may be realized by any given storage project, PG&E expects any given storage project to be capable of providing multiple products and uses. The technology-neutral focus should ensure that all storage systems capable of meeting operational requirements that satisfy the Commission's guiding principles are considered. This should also result in the most cost-effective procurement consistent with the Commission's intent.

The Commission included "co-located energy storage" under its "Use-Case Examples."[7] However, consistent with PG&E's technology-neutral approach, the co-location of energy storage with a generation resource is not considered a product or use by itself. It is only an attribute of an energy storage system that may enable it to provide combinations of products and uses identified in Table 4-1. For example, the co-location of storage at a solar facility may allow delivery of energy (a product) to the grid that was otherwise unavailable because if it had delivered at the time of production it may have exceeded the interconnection capacity amount. To the extent the co-location with generation resources adds value to an energy storage offer, it will be reflected in PG&E's evaluation of offers from its energy storage solicitation.[8]

C. Operational Requirements for PG&E's Products and Uses

The operational requirements for a storage project will be dictated by the specific products and uses offered by a storage project and will vary by its regulatory function, which will be either generation/market or transmission and distribution reliability. In the application and testimony, energy storage resources that perform a generation/market function are referred to as "Non-Generator Resources," as defined by California Independent System

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6 Described in Chapter 5.

7 Table 1 of D.13-10-040, p. 14, identifies some "Use-Case Examples" for different storage grid domains and regulatory functions.

8 Described in Chapter 5.

Operator (CAISO) Tariff, and resources that provide transmission and distribution reliability are referred to as "T&D Assets."[9] PG&E may also have additional operational requirements beyond those specified by CAISO, such as a requirement that all storage projects must be capable of responding to an electronic signal conveying dispatch instructions. PG&E's solicitation documents (including the contract form agreements) will define these additional operational requirements.

1. Generation / Market

The operational requirements for existing CAISO products identified in Table 4-1, such as ancillary services, will be dictated by the CAISO Tariff. More specific guidance regarding applicable PG&E operational requirements for generation/market uses in Table 4-1 that are not existing CAISO products will be included in PG&E's energy storage solicitation issued December 1, 2014.

2. Transmission and Distribution Reliability

The operational requirements for storage projects providing transmission and distribution reliability regulatory functions will include the capability of being operated in a manner consistent with PG&E's transmission and distribution equipment. More specifically, a storage system that is intended to defer a capital investment in the transmission or distribution system must be able to fulfill all the operational requirements that are specific to such capital investment. These operational requirements will vary by project, and will be identified in detail in specific request for offers for each project.

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9 "CAISO Tariff" means the CAISO Fifth Replacement FERC Electric Tariff and protocol provisions, including any CAISO-published procedures or business practice manuals, as it may be amended, supplemented or replaced (in whole or in part) from time to time. CAISO's tariff is available at https://www.caiso.com/rules/Pages/Regulatory/Default.aspx.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 5

EVALUATION METHODOLOGY

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 5
EVALUATION METHODOLOGY

TABLE OF CONTENTS

A. Introduction 5-1

1. Background 5-1

2. Utility-Specific Proprietary Evaluation Protocol 5-1

a. PG&E's Evaluation of Offers for Transmission- and Distribution-Connected Storage 5-2

b. PG&E's Evaluation of Offers Co-Located With Energy Generation Facilities 5-3

c. PG&E's Evaluation of Offers on Behind-the-Meter "Customer Side" Storage 5-4

d. PG&E's Evaluation of Utility-Owned Generation Offers in Storage RFO 5-4

3. Consistent Evaluation Protocol 5-5

B. PG&E's Evaluation Protocol 5-6

1. Net Market Value 5-9

a. Net Energy Value 5-9

b. Ancillary Services Value 5-10

c. Capacity Value 5-10

d. Variable Cost 5-11

e. Fixed Cost 5-11

2. Portfolio Adjusted Value 5-12

a. Location 5-12

b. Transmission Network Upgrade Cost 5-12

c. T&D Investment Deferral Value 5-13

d. Increased Efficiency for Fossil Generation 5-14

e. Renewable Generation Curtailment Support 5-15

3. Qualitative Criteria 5-15

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 5
EVALUATION METHODOLOGY

TABLE OF CONTENTS
(CONTINUED)

a. Project Viability 5-15

b. Supplier Diversity 5-16

c. Credit 5-16

d. Contract Modifications 5-16

e. Counterparty Concentration 5-17

f. Technology Diversity 5-17

C. Consistent Evaluation Protocol for Energy Storage Benchmarking and General Reporting Purposes 5-17

1. Background 5-17

2. Scope 5-17

3. Presentation Format for CEP 5-19

4. Confidentiality 5-19

5. Standardized Planning Assumptions 5-20

6. Descriptive Information Included in the CEP Spreadsheet 5-21

7. Quantitative Information Included in the CEP Spreadsheet 5-21

a. Net Market Value Overview 5-21

b. Capacity/Resource Adequacy Value 5-23

c. Energy Value 5-23

d. Ancillary Services Value 5-23

e. Distribution Investment Deferral Value 5-23

f. Fixed Capacity Payments and Fixed O&M Cost 5-24

g. Charging Costs and Variable O&M Cost 5-24

h. Network Upgrade Cost 5-24

i. GHG Compliance Cost 5-24

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 5
EVALUATION METHODOLOGY

TABLE OF CONTENTS
(CONTINUED)

j. Debt Equivalence Cost 5-25

k. Market Participation Costs 5-25

8. Qualitative Information Included in the CEP Spreadsheet 5-25

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 5
EVALUATION METHODOLOGY

A. Introduction

1. Background

As required in the Decision Adopting Energy Storage Procurement Framework and Design Program, approved October 17, 2013, in Rulemaking 10-12-007 (the Decision) and specified in Appendix A of the Decision, Section 3)d), Pacific Gas and Electric Company (PG&E) is providing in this chapter, "a proposed methodology for an analysis that evaluates bids on cost and fit submitted in a solicitation that draws on: The full range of benefits and costs identified in the use case framework developed and the Electric Power Research Institute (EPRI) and Det Norske Veritas (DNV) KEMA reports submitted in this proceeding;"[1] including both:

- A "utility-specific proprietary evaluation protocol" (PG&E's Evaluation).
- An "evaluation protocol consistent across the investor-owned utilities (IOU) that includes a consistent set of assumptions and methods for valuing storage benefits. . . to provide a consistent basis for comparison across utilities, bids, and use cases" (Consistent Evaluation Protocol or CEP).

2. Utility-Specific Proprietary Evaluation Protocol

PG&E plans to develop and implement its Storage Request for Offers (RFO) under the oversight of the Independent Evaluator (IE), the Procurement Review Group (PRG) and Energy Division (ED) staff. This includes the development and implementation of PG&E's Evaluation.

PG&E's Evaluation will apply the principles of its Least-Cost Best-Fit (LCBF) methodology, using quantitative and qualitative criteria based on information contained in the offer forms received through a Storage RFO[2]

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1 The EPRI and DNV KEMA energy storage cost-effectiveness reports are available here: http://www.cpuc.ca.gov/PUC/energy/electric/storage.htm.

2 Participants will be required to submit accurate figures, descriptions and calculations with their offers.

(the Offer). PG&E's Evaluation will include the "full range of benefits and costs identified in the use case framework developed and the EPRI and DNV KEMA reports submitted in this proceeding." The results from PG&E's Evaluation will inform PG&E's selection of Offers with which PG&E will enter into negotiations (Shortlisted Offers). PG&E's Evaluation, as described in Section B below, will apply to transmission-connected and distribution-connected storage,[3] but not behind-the-meter "customer-side" storage.[4]

a. PG&E's Evaluation of Offers for Transmission- and Distribution-Connected Storage

PG&E's Evaluation of Offers for transmission- and distribution-connected storage will cover four functions: (1) Generation/Market; (2) Transmission Reliability; (3) Distribution Reliability; and (4) Dual-Use (T&D Reliability and Market). PG&E's Evaluation of these regulatory functions will include quantitative and qualitative criteria. The quantitative criteria include Net Market Value (NMV) and Portfolio Adjusted Value (PAV).

NMV benefits include net energy, capacity and Ancillary Services (A/S) value. NMV costs include the offered fixed and variable pricing in the applicable agreement, a fixed overhead cost, and transmission network upgrade costs.

PAV includes adjustments that are relevant to PG&E's total energy portfolio, specifically for location, deferral or replacement of transmission and distribution (T&D) project costs, increased efficiency for fossil generation and renewable generation curtailment support. The qualitative criteria include project viability, credit, supplier diversity, contract terms and conditions, counterparty concentration and technology diversity.

The benefit of deferred or avoided T&D project costs will be evaluated for Offers that are located on PG&E-identified substations

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3 D.13-10-040, Table 1, p. 14.

4 Also called customer-sited or customer-connected storage. These types of resources will not be evaluated in the Storage RFO because customer-sited projects will be implemented through existing California Public Utilities Commission (CPUC or Commission)-approved programs outside of the Storage RFO.

and/or feeders. Such benefit will be assessed based on the deferred or avoided cost of the least expensive non-storage solution meeting the PG&E-identified operational need on that distribution location. This method compares energy storage projects directly to the T&D system project that would most likely be built in their absence. Such analysis will be based on the most current information available at the time the evaluation is performed. The main factors in the analysis for each alternative—storage or non-storage—include the installed cost, the operating and maintenance cost, project life, return on investment and discount rate.

PG&E will avoid double counting of benefits. For example, a dual-use storage project will be evaluated first as a T&D Asset that meets reliability needs, thus yielding a benefit of deferred or avoided T&D investment, before considering its wholesale market benefit as a Non-Generation Resource as defined by California Independent System Operator Corporation (CAISO) tariff. That is, the operational requirements to meet T&D reliability will be used as limiting constraints when determining the wholesale market benefits such as Resource Adequacy (RA) capacity, energy and A/S, so that these wholesale market benefits will not be available for hours in which the project is acting as a T&D asset. In addition, in accordance with the CAISO tariff, energy and A/S value will be computed in an integrated manner, such that each megawatt (MW) of capacity can be utilized at a specific time for either energy or A/S, but not both.

b. PG&E's Evaluation of Offers Co-Located With Energy Generation Facilities

Projects that are co-located with energy generation facilities represent special cases. Because their operation will be integrated with and dependent upon the operation of the associated generation facility, the NMV and PAV of the storage Offer must be calculated as the NMV and PAV of the combined facility.

For example, the calculations for a combined storage and Renewable Portfolio Standard (RPS) Offer that includes a new RPS-eligible generating facility will be based on the NMV and PAV

valuation methodology used in PG&E's most recent RPS RFO, updated for consistency with the valuation of the stand-alone storage.

If an Offer combines co-located storage with an existing energy generation facility that already has a Power Purchase Agreement (PPA) with PG&E, the Offer will be evaluated as the NMV and PAV of the combined project minus the NMV and PAV of the existing PPA. Thus the NMV and PAV value of any incremental energy achieved from the generation facility because of co-locating energy storage will be included in the valuation.

Depending on the exact configuration of the facility, including interconnection details such as whether the storage facility can be charged from the grid or only from the generation facility and the characteristics of the generation and storage facilities, co-location with a generation facility could increase or decrease the value of a storage project compared to an identical stand-alone storage project.

c. PG&E's Evaluation of Offers on Behind-the-Meter "Customer Side" Storage

Customer-connected energy storage projects will be implemented within existing CPUC-approved programs—currently Self-Generation Incentive Program (SGIP), Permanent Load-Shifting (PLS), Demand Response (DR), and Electric Vehicle (EV) pilots—and not through a Storage RFO. Each of these programs has its own evaluation metrics defined under each specific program. PG&E requests that the evaluation of customer-connected projects remain within each CPUC-approved program implemented for behind-the-meter storage.

d. PG&E's Evaluation of Utility-Owned Generation Offers in Storage RFO

The Energy Storage Decision authorizes utilities to consider utility-owned generation (UOG) for up to 50 percent of the overall procurement targets.[5] PG&E will evaluate UOG Offers submitted by

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[5] Conclusion of Law 31 of Decision 13-10-040 in Rulemaking 10-12-007, "Order Instituting Rulemaking Pursuant to Assembly Bill 2514 to Consider the Adoption of Procurement Targets for Viable and Cost-Effective Energy Storage Systems" stated, "It is reasonable to limit utility ownership of storage systems to 50% across grid domains."

third parties (turnkey Purchase and Sale Agreements or PSA) or, potentially, by PG&E itself (Engineering, Procurement and Construction contracts or EPC) on a head to head, competitive basis.

As described in Section A.1, to ensure the fairness of this process, PG&E plans to develop and implement its Storage RFO under the oversight of the IE, PRG and ED staff. This includes the development and implementation of PG&E's Evaluation.

In addition, PG&E will develop a code of conduct, to be signed by any and all PG&E personnel involved in the Storage RFO process to prevent sharing of sensitive information between PG&E employees involved in evaluating "owner's costs" associated with a third-party or a utility-developed Offer for a utility-owned storage project and PG&E employees who create PG&E's Evaluation criteria and select Shortlisted Offers.

PG&E's Evaluation will perform an apples-to-apples comparison of utility-build and third-party-build Offers in PG&E's Storage RFO. To do this comparison, PG&E will employ its LCBF methodology, as embodied in PG&E's Evaluation described in this chapter, taking into account the quantitative and qualitative attributes associated with each Offer.[6]

This apples-to-apples comparison will appropriately weigh the differences in the quantitative and qualitative attributes associated with utility-build and third-party-build Offers.

Finally, if PG&E submits a utility-build Offer, it will track its Offer development costs separately[7] and add these costs to the cost of the project in PG&E's Evaluation. If the utility-build Offer does not result in a used and useful capital asset, such development costs will not be eligible for cost recovery in the future.

3. Consistent Evaluation Protocol

As required in the Decision, the IOUs conferred with ED staff "to develop a consistent evaluation protocol to be used for *benchmarking and general*

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6 This includes "performance risk, credit risk, price diversity (10 vs. 20-year price terms), and operational flexibility etc." as stated in Finding of Fact 86 in Decision 04-12-048.

7 Via specific expense and/or capital order(s) in PG&E's SAP accounting system.

reporting purposes.[8] [Emphasis added.] The CEP includes both quantitative and qualitative information. The CEP is not meant to directly correlate to IOU-specific evaluation or shortlisting criteria. Therefore, the outcome under the CEP likely will differ from the outcome under the IOU specific evaluation protocol. The CEP is described in detail in Section C below.

B. PG&E's Evaluation Protocol

PG&E will evaluate each Offer received in the Storage RFO using quantitative and qualitative criteria, which may include, but are not limited to:

Quantitative Criteria:

1. NMV
   a. Benefits (Energy, A/S, Capacity)
   b. Fixed and Variable Costs
2. PAV
   a. Location
   b. Cost of Transmission Network Upgrade
   c. T&D Investment Deferral Value
   d. Increased Efficiency of Fossil Generation
   e. Renewable Generation Curtailment Support

Qualitative Criteria:

1. Project Viability
2. Supplier Diversity
3. Credit
4. Contract Modifications
5. Counterparty Concentration
6. Technology Diversity

Offers are evaluated using the following step-by-step process:

First, NMV is computed for each Offer. NMV intends to represent the value of an Offer from the market perspective (e.g., the Generation/Market regulatory function). The NMV captures the market value provided by an Offer of Energy, A/S, and Capacity and compares it to the Offer's cost. However, NMV does not

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[8] D.13-10-040, p. 63.

include the benefits and costs associated with an Offer's impact on PG&E's portfolio. That is captured by PAV.

Second, PG&E makes explicit and systematic adjustments to NMV to incorporate the value of an Offer with respect to PG&E's entire portfolio. To arrive at PAV, the NMV will be adjusted by criteria such as the Offer's location, transmission network upgrade cost, benefit of deferred or avoided T&D investment cost,[9] and effects on other generation in PG&E's portfolio. Table 5-1 provides a mapping of NMV and PAV benefit and cost components for each energy storage product and use identified previously in Chapter 4, Table 4-1.

Third, after the calculation of PAV is complete, PG&E considers qualitative criteria, including project viability, supplier diversity, credit of the counterparty, the extent of proposed modifications to the standard form contract, counterparty concentration and technology diversity.

Lastly, Offers will be ranked using PAV as the common benchmark for comparison. Shortlisted Offers will typically be drawn from projects with the more favorable PAV results and qualitative criteria.

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9 In the case of a dual-use regulatory function—including both reliability and market functions—the reliability operating requirements will be satisfied first before estimating any remaining energy and A/S values from the market when calculating NMV and PAV. This is done to avoid double-counting benefits.

TABLE 5-1
PACIFIC GAS AND ELECTRIC COMPANY
NMV/PAV COMPONENTS FOR EACH PG&E PRODUCT AND USE

Line No.	Guiding Principles	PG&E's Products and Uses	Location of Connection	Regulatory Function	NMV/PAV Ben Component
1	Optimization of the Grid	Black Start Capability(b)	Transmission	Generation/Market	TBD
2		System and Local Resource Adequacy(c)	T&D	Generation/Market	Capacity Val
3		Frequency Response (Inertia)(d)	T&D	Transmission Reliability	TBD
4		T&D Capacity Upgrade Deferral(e)	T&D	T&D Reliability	T&D Investment D Value
5		T&D Reliability Upgrade Deferral(f)	T&D	T&D Reliability	T&D Investment D Value
6	Integration of Renewable Energy	Frequency Regulation(b)	T&D	Generation/Market	A/S Value
7		Spinning/Non-Spinning Reserves(b)	T&D	Generation/Market	A/S Value
8		Flexible Ramping Product(g)	T&D	Generation/Market	A/S Value
9		Over-Generation and Curtailment Support(h)	T&D	Generation/Market	Energy Value + Re Curtailment Su
10		Energy Shifting(i)	T&D	Generation/Market	Energy Valu
11		Flexible Resource Adequacy(j)	T&D	Generation/Market	Capacity Val
12		Reduces Intermittency of Renewable Resource(k)	T&D	Generation/Market	A/S Value
13	Reduction of Greenhouse Gas (GHG) Emissions	Energy Shifting(i)	T&D	Generation/Market	Energy Valu
14		Over-Generation and Curtailment Support(h)	T&D	Generation/Market	Energy Value + Re Curtailment Su
15		Improves Efficiency for Fossil Generation(l)	T&D	Generation/Market	Fossil-Fueled Gen Efficiency Incr

(a) Cross-reference with Storage End Use in Figure 2 of Energy Storage Framework Staff Proposal (http://www.cpuc.ca.gov/NR/rdonlyres/2A 46414F3248F5/0/EnergyStorage_FinalStaffProposal.dcx).

(b) See CAISO Tariff (https://www.caiso.com/Documents/ConformedTariff_Dec17_2013.pdf), Section 8.

(c) See the Commission's Resource Adequacy program (http://www.cpuc.ca.gov/PUC/energy/Procurement/RA/ra_history.htm) and the CAIS http://www.caiso.com/planning/Pages/ReliabilityRequirements/Default.aspx).

(d) See proposed CAISO initiative (http://www.caiso.com/Documents/Draft2013StakeholderInitiativesCatalogRevisedJan28_2014.pdf) on Fre

(e) Refers to the ability of storage to defer a planned transmission or distribution capacity upgrade investment.

(f) Refers to the ability of storage to defer a planned transmission or distribution reliability upgrade investment.

(g) See CAISO initiative (http://www.caiso.com/informed/pages/stakeholderprocesses/flexiblerampingproduct.aspx on Flexible Ramping Prod

(h) Refers to the ability of storage to charge during over-generation or negative price periods and discharge during non-binding periods.

(i) Refers to the ability of storage to charge during relatively lower priced off-peak periods and discharge during relatively higher priced peak

(j) See the Commission's current RA proceeding (Rulemaking 11-10-023) and the CAISO's Flexible Resource Adequacy Criteria and Must-C initiative (http://www.caiso.com/informed/pages/stakeholderprocesses/flexibleresourceadequacycriteria-mustofferobligations.aspx).

(k) Refers to the ability of storage to firm the intermittency that a renewable resource delivers to the transmission and distribution system by c renewable output and discharging during times of low renewable output.

(l) Refers to the ability of storage to lower the average GHG emissions rate the fleet of fossil-fires resources or of a single fossil-fired resourc starts in the fleet or by reducing a particular unit's actual heat rate.

1. Net Market Value

Net Market Value compares an Offer's costs to its market value. NMV is calculated for each Offer as follows:

Net Market Value: NMV = (E + A + C) – (V + F)

Where:

E = Net Energy Value = Value of discharging energy – cost of charging

A = A/S Value

C = Capacity Value

V = Variable Cost

F = Fixed Cost

The risks and uncertainties associated with an Offer's costs and benefits will be considered as part of Market Valuation. These costs and benefits do not include the costs and benefits associated with an Offer's impact on PG&E's portfolio. In order to estimate Net Energy Value, A/S Value, and Fixed and Variable Costs, a time series of the energy charge, energy discharge, and A/S awards will be developed from a co-optimization algorithm based on the resource characteristics of the Offers and projected market prices for Energy and A/S.

a. Net Energy Value

PG&E will assess the market value[10] of the energy deliveries for each Offer based on charging and discharging time series obtained for the Offer over its delivery term. As mentioned above, any capacity used to meet reliability needs for the transmission or distribution system will be reserved first, to avoid double counting benefits. The market value of the energy will be computed from the appropriate price curves for the corresponding Trading Hub (North of Path 15 (NP15), in between NP15 and SP15 (ZP26), or South of Path 15 (SP15)) adjusted for its location. The Locational Marginal Price (LMP) multipliers may be used to incorporate congestion and losses specific for the location, and therefore value the contribution to transmission congestion relief.

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10 Market value of energy includes GHG compliance costs, so impact on GHG is implicitly included in energy value.

The cost of Charging Energy (grid energy used to charge Energy Storage) will also be included in the Net Energy Value.

b. Ancillary Services Value

For Offers that provide PG&E the ability to schedule and receive CAISO market revenues for A/S in accordance with CAISO tariff requirements, the incremental benefit of having A/S capability will be captured. As mentioned above, time series for A/S awards will be jointly determined with energy time series to avoid double counting the value.

A/S revenues will include revenues from providing Regulation Up (RegUp), Regulation Down (RegDn), and Spinning Reserves (Spin). Pay-For-Performance revenues associated with providing RegUp and RegDn may be included. The A/S value of each Offer will be assessed based on the time series of A/S awards obtained for the Offer over its delivery term using the projected market prices for RegUp, RegDn, Spin, and potentially Pay-for-Performance.[11]

PG&E will assume that the values from providing Non-Spinning Reserves (Nonspin) in addition to Spin are negligible because the price for Nonspin is never higher than the Spin price and thus capturing Spin value would suffice.

PG&E will look into the possible values from currently bilateral A/S products such as black start and future CAISO A/S products such as flexible ramping and inertia to estimate their value if PG&E anticipates that there could be significant incremental value for some Offers from providing such products.

c. Capacity Value

The value of RA capacity associated with each Offer will be determined based on the projected monthly quantity of: (a) Net Qualifying Capacity (NQC, for Generic RA); and (b) Effective Flexible Capacity (EFC, for Flexible RA). Resources that are expected to be found fully deliverable by the CAISO will be attributed the full Generic

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11 PG&E will take into account the limited size of regulation and spin markets when evaluating for A/S values for all Offers.

RA capacity value for its projected NQC.[12] To the extent that an Offer provides flexible capacity, the EFC capacity that is expected to count and meet the must-offer obligation for flexible RA will be evaluated at the projected monthly premium for flexible RA and added to the Capacity Benefit.[13]

d. Variable Cost

Variable cost for an Offer will be calculated as the sum of variable payments, which will be based on the variable operations and maintenance (VOM) price multiplied by the discharge time series obtained for the Offer. Variable cost will also include the cost of fuel (other than grid energy) and/or start-up costs, if applicable, but to avoid double-counting will not include the market costs for Charging Energy. The contract VOM price will affect the discharge time series—all other things being equal, a lower VOM would result in more energy charging and discharging both in PG&E's Evaluation and in actual operation.

e. Fixed Cost

Fixed Cost for an Offer will be calculated as the sum of projected monthly fixed payments. Monthly fixed payments will be based on the capacity payment price and the monthly contract capacity specified in the Offer (or the energy payment price in dollars per megawatt-hour ($/MWh) for a storage resource co-located with a RPS resource).

Each Offer will also be assigned an annual fixed overhead cost (independent of the size of the project) representing administrative costs plus the cost of scheduling into CAISO markets.

Fixed Cost for a PSA Offer will also be collected by PG&E's Cost of Service Model to determine the revenue requirement (mainly

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12 See the Commission's Resource Adequacy program (http://www.cpuc.ca.gov/PUC/energy/Procurement/RA/ra_history.htm) and the CAISO Reliability Requirements http://www.caiso.com/planning/pages/reliabilityrequirements/default.aspx).

13 See the Commission's current RA proceeding (R.11-10-023) and the CAISO's FRACMOO initiative (http://www.caiso.com/informed/pages/stakeholderprocesses/flexibleresourceadequacycriteria-mustofferobligations.aspx).

depreciation, return, taxes, and fixed operations and maintenance (O&M)) based on initial capital costs and fixed O&M of the facility.

2. Portfolio Adjusted Value

PG&E will calculate PAV to derive the value of each Offer from the perspective of PG&E's portfolio, not just from the market perspective. PAV may include the adjustments to the NMV based on factors including but not limited to: (1) Location; (2) Transmission Network Upgrade Costs; (3) T&D Investment Deferral Value; (4) Increased Efficiency for Fossil Generation; and (5) Renewable Generation Curtailment Support.

a. Location

PG&E has a preference for projects in its service territory. A project located closer to PG&E's load is likely to have more value for PG&E's bundled electric portfolio, even when market forward prices for energy indicate that energy delivered farther away has greater Market Value. There is long-term risk for PG&E's customers when resources are located outside of PG&E's service territory rather than within PG&E's service territory. This preference is influenced in part by the limit on the total amount of capacity that utilizes Path 26 that can be counted toward PG&E's RA capacity requirement. The calculation of PAV effectuates this by adjusting the values of both energy and capacity for Offers from resources in SP15. Offers for energy storage from projects in NP15 will be adjusted to have an equal or higher PAV than comparable Offers from resources in SP15, even if the LMPs would drive the PAV in the other direction.

For an Offer in a location that is projected to contribute to PG&E's satisfaction of a Local Capacity Requirement, the Offer's capacity may be evaluated at a premium relative to the value of similarly-flexible capacity that satisfies only system needs.

b. Transmission Network Upgrade Cost

Transmission availability and transmission-related costs will be part of an Offer's PAV. PG&E may use results from Projects' interconnection studies, if available. Network upgrades include all facilities necessary to: (1) reinforce the transmission system after the point where a

project's electricity first interconnects with and enters the subject utility's transmission grid; and (2) transmit or deliver the full amount of generation to or from the Project.[14] Transmission cost adders reflect the cost of potential network upgrades borne by customers. Any transmission cost adders attributed to the Project will also be considered in ranking Offers.

The Participant shall include in its bid price the estimated cost of all the facilities needed to interconnect the storage project to the first point of interconnection with the transmission system grid.[15] Because these costs are in the bid price and not to be refunded by the customers, they are not included in the calculation of the transmission adder.

c. T&D Investment Deferral Value

In the package sent to participants in PG&E's Storage RFO, PG&E will provide both the locations where energy storage provides an alternative to a T&D investment, as well as the operational requirements, e.g., MW capacity and duration, associated with each location. For Offers that meet PG&E-identified operational requirements on PG&E-identified substations and/or feeders, the value of deferred T&D investment costs will be estimated.

The value of deferring T&D investment costs is unique to a specific location. The baseline for such deferred value will be the Net Present Value (NPV) of the expected cost stream of the least expensive non-storage investment that could meet PG&E's operational requirements at the specified location (the Non-Storage Alternative).[16]

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14 Network upgrades include transmission lines, transformer banks, special protection systems, substation breakers, capacitors, and other equipment needed to transfer power to the consumer. Network upgrades are typically upfront funded by Participants, and refunded after commercial operation. The costs of network upgrades are included in transmission rates and paid by customers. For projects that are fully deliverable, PG&E will consider both reliability and deliverability network upgrades.

15 These facilities are referred to as direct assignment facilities, or "gen-ties." Direct assignment facilities include the transformer bank used to step-up the storage project output to transmission voltage, the outlet line between this step-up transformer bank and the transmission system, and protection and communication facilities needed for interconnection and safe operation of the project.

16 In calculating the NPV of the Non-Storage Alternative, the initial capital cost, ongoing O&M costs, return on investment, discount rate and similar factors will be considered.

The value of deferring T&D investment costs for an energy storage Offer is the difference in NPV between the expected cost stream of the Non-Storage Alternative and the NPV of the expected cost stream of an energy storage project that meets the same operational requirements at the specified location for the project's effective lifetime, plus the NPV of the deferred non-storage investment that is implemented at the end of the storage project's life (the Storage Alternative).

Note that if the Storage Alternative has remaining life but no longer meets the operational requirements, it could be moved to another location where it could provide operational requirements and generate additional value going forward.

Any expected net market benefit (or cost) from meeting charging and discharging requirements to perform the T&D operating requirements will be included in the energy component of NMV. Whenever the Storage Alternative has a dual-use regulatory function—including both reliability and market functions—the reliability operating requirements will be satisfied first before estimating any remaining energy and A/S values from the market when calculating NMV. This is done to avoid double-counting benefits.

d. Increased Efficiency for Fossil Generation

Energy storage has the potential for allowing gas-fired generation in PG&E's portfolio to run with fewer startups and to operate more efficiently. Not only would such efficiency reduce costs but also it would reduce GHG emissions. PG&E will estimate the cost of fuel, GHG compliance instruments, and start-ups to PG&E's portfolio that energy storage can help avoid. Such avoided cost would differ among Offers due to the variation in characteristics of those Offers.

Note that some thermal energy storage projects provide local efficiency gains by e.g., pre-cooling inlet air or delivering pure oxygen to a gas generator. Such localized benefits will be included in NMV based on the improved NMV of the associated gas generator.

e. Renewable Generation Curtailment Support

Higher penetration of renewable energy increases the likelihood of curtailment being used to avoid over-generation, negative energy prices, and reliability problems. Storage can help reduce the curtailment of intermittent generation in PG&E's portfolio, benefiting PG&E's customers by reducing the instances of over-generation as well as by increasing total generation from the renewable portfolio that contributes to meeting PG&E's RPS requirements. In PAV, PG&E will incorporate relative effectiveness in reducing possible renewable curtailments, which will depend on characteristics (e.g., charge duration) of energy storages.

3. Qualitative Criteria

a. Project Viability

PG&E may review the likelihood that any resource(s) associated with an Offer can satisfy the requirements of the Agreement. This assessment may be based on a review of the status and plans for key project activities (e.g., financing, site access, permitting, engineering, procurement, construction, interconnection, start-up and testing, operations, fuel supply, water supply, wastewater discharge, labor agreements, etc.).

The project viability analysis may include an evaluation of the environmental characteristics and environmental impacts of a project. The evaluation may consider environmental permitting (e.g., Participant's identification of required permits, schedule for acquisition of all necessary permits, and a reasonable demonstration of its ability to comply with all applicable environmental laws and regulations through the contract term) and environmental impacts to air quality, water (including water usage and discharge water quality and quantity), and solid and hazardous waste generation and disposal. The evaluation may also consider environmental leadership, which may include, but is not limited to, community relations, proximity to other emitting and discharging facilities, and the use of (or plans to upgrade to) advanced environmental technology to reduce impacts. The review

of an Offer may include the technical reliability of an Offer to assess how the project's plant configuration, operating characteristics, and plant operations are likely to meet the Agreement's performance requirements.

b. Supplier Diversity

It is the policy of PG&E that Women, Minority and Disabled Veterans Business Enterprise (WMDVBE) shall have the maximum practicable opportunity to participate in the performance of Agreements resulting from this Storage RFO. PG&E encourages Participants to carry out PG&E's policy and contribute to PG&E's supplier diversity goal by achieving greater than 30 percent of all procurement with WMDVBEs. The Supplier Diversity evaluation would take into account the Participant's status as a WMDVBE, intent to subcontract with WMDVBEs, and the Participant's own Supplier Diversity Program.

Supplier Diversity may be a consideration in the selection process. If Participant is selected and an applicable agreement is negotiated, the agreement will include a requirement to make good faith efforts toward meeting the contracted supplier diversity target, and successful bidder(s) will be expected to report payments made to WMDVBEs to support the project, upon request but no less than annually.

c. Credit

PG&E may consider the Participant's capability to perform all of its financial and financing obligations under the Agreements and PG&E's overall credit concentration with the Participant or its banks, including any of Participant's affiliates.

d. Contract Modifications

PG&E may assess the materiality and cost impact of any of Participant's proposed modifications to Storage RFO requirements and the applicable Agreement or term sheet. PG&E strongly encourages Participants to only make those changes to the Agreement that address particular technology, project development or operational issues.

e. Counterparty Concentration

PG&E may consider the volume of energy or capacity already under contract from a particular counterparty, as well as Offers received in this Storage RFO.

f. Technology Diversity

PG&E may consider the diversity of resources submitted in the RFO when evaluating Offers for PG&E's shortlist.

C. Consistent Evaluation Protocol for Energy Storage Benchmarking and General Reporting Purposes

1. Background

The Decision Adopting Energy Storage Procurement Framework and Design Program (the Decision) requires the IOUs to confer with Energy Division Staff to develop a consistent evaluation protocol to be used for benchmarking and general reporting purposes.[17] Accordingly, PG&E, San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) worked with the Energy Division to create this CEP document.

In Appendix A of the Decision, Section (3)(d), the CEP is described further as the following.

> An evaluation protocol consistent across the IOUs that includes a consistent set of assumptions and methods for valuing storage benefits, such as market services and avoided costs, and estimating project costs that allow adjustments for utility-specific factors (such as location, portfolio, cost of capital, etc.) and utility-specific modeling tools based outputs affecting valuation as appropriate to provide a consistent basis for comparison across utilities, bids, and use cases.

The CEP includes both quantitative and qualitative information. The CEP is not meant to directly correlate to IOU specific evaluation or shortlisting criteria. Therefore, the outcome under the CEP will differ from the outcome under the IOU-specific evaluation protocol.

2. Scope

Nothing in the CEP is to be construed or implied as restricting or invalidating the assumptions, models, tools, and analysis each IOU might choose to value, rank, or shortlist the physical and financial merits of offers

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[17] D.13-10-040, at 63.

or bids from the IOUs' energy storage solicitations (Offers) that might be received to comply and fulfill each IOU's energy storage needs at the transmission, distribution, and customer levels.

As stated in the Decision, the CEP is only for "benchmarking and general reporting purposes" and is not a replacement for the IOUs' individual, proprietary, evaluation protocols to be used to evaluate the cost and benefits or other quantitative or qualitative aspects of Offers resulting from IOU energy storage solicitations.

The CEP is focused on the methodology to determine NMV.[18] For the CEP to yield consistent numerical results across the IOUs for reporting purposes, publicly available information will be used as a substitute for the confidential, commercially sensitive inputs the IOUs will use in evaluation of actual commercial Offers from market participants.

Beyond NMV, each IOU will have specific qualitative and quantitative elements that will be used to evaluate and select energy storage projects. Those IOU-specific qualitative and quantitative elements are not included in the CEP and will not be limited by the CEP. The Decision clarifies this intent as follows.

> We agree with parties that any actual finding of cost-effectiveness should only be done in a utility application for approval of storage contracts or rate-based additions, where there is a specific project and actual project inputs. . . . As such, we *shall allow the IOUs to propose their own methodology to evaluate the cost and benefits of bids.*[19] [Emphasis added.]

The CEP shall not be implemented into a model. To complete the CPUC's benchmarking and reporting goals, each IOU will evaluate the quantitative and qualitative elements of short-listed energy storage projects through its respective models, albeit using publicly available input assumptions needed to calculate NMV. Given that the purpose of the CEP is to provide a succinct comparison tool for storage Offers, it is not possible to capture every cost and benefit of storage Offers in the CEP. The scope of the CEP includes all three of the storage domains defined in the

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18 Described in Section 7 below.

19 D.13-10-040, p. 63.

Decision—transmission, distribution and customer—in either a quantitative or qualitative form.

3. Presentation Format for CEP

The presentation format for Offers under the CEP will be an electronic spreadsheet, an example of which is included as Attachment 5A of this chapter of testimony (the Spreadsheet).[20] The Spreadsheet will include prescribed column headings for information describing the Offers. Per the Decision, this information will be based on a, "consistent set of assumptions and methods for valuing storage benefits" as described herein. For each of the Offers, the Spreadsheet will include:

- Descriptive Information about the Offers and their proposed projects, as described in Section 6 below.
- Quantitative Information consisting of an NMV calculation, inputs to NMV, and the benefit and cost components used to calculate NMV, as described in Section 7 below.
- Qualitative Information consisting of a "yes/no" indication of which energy storage end uses[21] might exist for each of the Offers, as described in Section 8 below.

The Spreadsheet will not include all evaluation rating or ranking elements or criteria that may be considered in utilities' evaluations of Offers. For example, the Spreadsheet does not capture information on: (1) Location; (2) Portfolio Need; (3) Contract Length; (4) Project Viability; (5) Supplier Diversity; (6) Credit Status including Counterparty Concentration; (7) Number of Proposed Modifications to the PPA; and (8) the Offer's consistency with and contribution to California's goals for the energy storage program.

4. Confidentiality

Information provided to the Commission via its staff is confidential under California Public Utilities Code Section 583 and confidentiality requirements contained in Decisions 06-06-066 and 13-10-040. However, such

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20 This document and its attached spreadsheet constitute the CEP in its entirety.

21 As identified in the Decision Adopting Proposed Framework for Analyzing Energy Storage Needs (D.12-08-016), August 6, 2012, at 23.

information may be shared with the CAISO, each IOU's Procurement Review Group (PRG), or any other regulatory agencies under the appropriate confidentiality protection, without destroying the confidentiality protection afforded by the Commission.

5. Standardized Planning Assumptions

The calculation of NMV requires assumptions for several inputs, including, but not limited to:

- Forecast hourly energy prices
- Forecast capacity prices
- Forecast ancillary services value[22]
- Forecast monthly natural gas prices
- Discount rate
- System loss factors
- Forecast GHG costs

For any calculations under CEP, publicly available information will be used. One of the Commission's consultants, Energy and Environmental Economics (E3)[23] produced an avoided cost calculator, which provides some public information. This avoided cost calculator includes a publicly available forecast of natural gas prices using the 2011 Market Price Referent (MPR) methodology and a public forecast of GHG prices using the 2009 MPR methodology.[24] In addition, E3's avoided cost calculator also includes public price forecasts for energy and capacity, system loss factors for each IOU, and discount rates for each IOU.[25] The most recent avoided cost calculator is named "DERAvoidedCostModel_v3.9_2011 v4d.xlsm"

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22 In the absence of a publicly available forecast of ancillary services prices, the CEP will use surrogate prices for ancillary services based on agreed upon monthly percentages of energy prices.

23 For background, note that E3 also produced the Commission's MPR model.

24 The MPR models are available at http://www.ethree.com/public_projects/cpuc3.php.

25 E3's describes the source of inputs—e.g., discount rate, system losses and GHG costs—and calculation methodology of outputs—e.g., energy, capacity and natural gas prices—for the publicly available information in its avoided cost calculator in two documents at http://www.ethree.com/public_projects/cpucdr.php. The names of the two documents are: "Revised DG Cost Effectiveness Framework Avoided Cost Methodology Description" and "Avoided Cost Methodology Description."

and is available on E3's website.[26] The aforementioned information from E3's avoided cost calculator will be included in the CEP as input assumptions.

6. Descriptive Information Included in the CEP Spreadsheet

The CEP Spreadsheet will include descriptive information about the Offers as listed in Table 5-2.

TABLE 5-2
PACIFIC GAS AND ELECTRIC COMPANY
DESCRIPTIVE INFORMATION INCLUDED IN THE CEP SPREADSHEET

IOU (PGE/SCE/SDG&E)	**Commercial Operation Date**	**Self-Discharge** in Stand-by (MW/hour)
Name of Shortlisted Project	**Term** (Years)	**Ramp Rate** – Charge/Discharge, Up/Down (MW/hour)
Interconnection Voltage (kV)	**Max Capacity** – Charge/Discharge at Grid Connection Point (MW)	**AGC** (Yes/No)
Interconnection Level (Transmission/Distribution)	**Min Capacity** – Charge/Discharge at Grid Connection Point (MW)	**Regulation at Zero** – Up/Down (Yes/No)
Local Capacity Area	**Qualifying RA Capacity** (MW)	**Contract Cost ($)**
Zone (NP/ZP/SP)	**Duration** of Max Sustainable Discharge Rate (Hours)	**Variable O&M** for Discharging ($/MWh)
Status (New/Existing)	**Efficiency** at Max Capacity (%)	**Fixed O&M** dollars per kilowatt-year ($/kW-year)
Product (Dispatchable/RA)	**Max Daily Switches** – Charge/Discharge (# Charges per Day)	
Energy Storage Technology	**Max Cycles** per Lifetime (# Cycles)	

7. Quantitative Information Included in the CEP Spreadsheet

a. Net Market Value Overview

For the CEP, the Offers will be evaluated in terms of $/kW. NMV is the NPV of future benefits minus future costs for the projects resulting

[26] http://www.ethree.com/public_projects/cpuc5.php.

from the Offers. The benefits will include the items listed in Table 5-2, levelized in $/kW. Costs will be defined as the direct and indirect, fixed and variable costs of a given project over its term. Costs will include the items listed in Table 5-2, levelized in $/kW. The CEP Spreadsheet will include quantitative information about the Offers as listed in Table 5-3 below.

TABLE 5-3
PACIFIC GAS AND ELECTRIC COMPANY
QUANTITATIVE INFORMATION INCLUDED IN THE CEP SPREADSHEET

Market Benefits (Levelized $/kW)	**Market Costs** (Levelized $/kW)
Capacity/Resource Adequacy Value	Fixed Capacity Payments and Fixed O&M Cost
Energy Value	Charging Costs and Variable O&M Cost
Ancillary Services Value	Network Upgrade Cost (Paid by CAISO Consumers)
Distribution Investment Deferral Value (If Applicable to Project)	GHG Compliance Cost (If Applicable to Project)
	Debt Equivalency Cost
	Market Participation Costs

NMV is calculated for each Offer with the following formula based on publicly available information:

$$NMV = (C + E + AR + DD) – (F + V + N + GHG + DE + MPC)$$

Where:

C = Capacity/Resource Adequacy Value

E = Energy Value

AR = Ancillary Services Market Value

DD = Distribution Investment Deferral Value

F = Fixed Capacity Payments and Fixed O&M Cost

V = Charging Costs and Variable O&M Cost

N = Network Upgrade Cost

GHG = GHG Compliance Cost (if applicable to project)

DE = Debt Equivalency Cost

MPC = Market Participation Costs

b. Capacity/Resource Adequacy Value

The value of capacity/RA associated with each Offer will be determined based on the projected monthly qualifying RA capacity and publicly available forecast capacity prices.

c. Energy Value

The market value of energy deliveries is based on the hourly generation profile of each Offer considering operating characteristics and limitations, such as delivery date, delivery term and delivery location and operational constraints. The market value of the energy will be based on the publicly available forecast energy prices. The quantity of energy delivered will be an output of each IOU's dispatch modeling tool. System loss factors both at the transmission and distribution level depending on the interconnection will be used to incorporate losses specific for each IOU.

d. Ancillary Services Value

A/S value will be assessed based on the A/S capability of each Offer. In the absence of a publicly available forecast of A/S prices, the CEP will use surrogate prices for A/S based on agreed upon monthly percentages of hourly energy prices.[27] A/S values will be determined by each IOU's dispatch modeling tool using the surrogate A/S prices. An energy storage device can generally operate in either the A/S market or the real time energy market but not both.

e. Distribution Investment Deferral Value

For Offers that provide a distribution investment deferral value, as calculated by each IOU using its own criteria, the resultant value will be shown for benchmarking and reporting purposes.

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27 Before utilities submit their completed CEP Spreadsheets including information on their shortlisted Offers, the IOUs will work with the Energy Division to determine the appropriate A/S price forecast to be used in the CEP valuation.

f. Fixed Capacity Payments and Fixed O&M Cost

The fixed payments for the project will be provided in the Offers.

g. Charging Costs and Variable O&M Cost

Charging costs for energy storage includes the cost of electricity to charge the project. The source of VOM, station use and other variable costs will be provided in the Offers. The amount of charging used by an energy storage project will be determined by each IOU's dispatch modeling tool.

h. Network Upgrade Cost

Transmission or distribution network-related costs will be part of the Offer's NMV. The IOUs may obtain and use results from Participants' interconnection studies, if available. Otherwise each IOU will develop and use its own estimate for transmission and distribution network upgrade costs.

Each Offer will include in its bid price the estimated cost of all the facilities needed to interconnect the project to the first point of interconnection with the transmission system grid. These facilities are referred to as direct assignment facilities, or "gen-ties." Because these costs are in the bid price, they are not included in the calculation of the transmission adder.

Network upgrades include all facilities that: (1) enable the project to be fully deliverable for RA counting purposes (upgrades after the point where a project's electricity first interconnects with and enters the subject utility's transmission grid); and (2) transmit or deliver the full amount of power from the Project. Network upgrades include: (a) transmission lines; (b) transformer banks; (c) special protection systems; (d) substation breakers; (e) capacitors; and (f) other equipment needed to transfer power to the consumer.

i. GHG Compliance Cost

For any energy storage project that includes technology that generates GHG emissions, a GHG compliance cost will be calculated and included in the NMV.

j. Debt Equivalence Cost

Long-term procurement contracts held by IOUs are treated by credit rating agencies as equivalent to long-term debt. This "debt equivalence" increases an IOUs borrowing costs.

k. Market Participation Costs

For example, in order to arbitrage the day-ahead and real-time market, the storage device must overcome the difference between the day-ahead and real-time Grid Management Charge (GMC) cost.

8. Qualitative Information Included in the CEP Spreadsheet

To incorporate some qualitative value that cannot be captured in the quantitative metrics, the CEP Spreadsheet also includes a grid of 20 end-uses as identified in the Decision Adopting Proposed Framework for Analyzing Energy Storage Needs[28] and listed in Table 5-4, below. For each offer, the utility will identify which end uses are present. However, there will be no specific quantitative assessment of the benefits of end uses in the CEP Spreadsheet, other than those qualities already captured in the quantitative metrics discussed in the previous section.

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28 Decision Adopting Proposed Framework for Analyzing Energy Storage Needs (D.12-08-016), August 6, 2012, at 23.

TABLE 5-4
PACIFIC GAS AND ELECTRIC COMPANY
END USES INCLUDED IN THE CEP SPREADSHEET

1. Ancillary Services: frequency regulation	8. Intermittent resource integration: wind (ramp/voltage support)	15. Distribution peak capacity support (upgrade deferral)
2. Ancillary services: spin/ non-spin/replacement reserves	9. Intermittent resource integration: photovoltaic (time shift, voltage sag, rapid demand support)	16. Distribution operation (voltage/Value at Risk (VAR) support)
3. Ancillary services: ramp	10. Supply firming	17. Outage mitigation: micro-grid
4. Black start	11. Peak shaving	18. Time-of-use (TOU) energy cost management
5. Real-time energy balancing	12. Transmission peak capacity support (upgrade deferral)	19. Power quality
6. Energy price arbitrage	13. Transmission operation (short duration performance, inertia, system reliability)	20. Back-up power
7. Resource Adequacy	14. Transmission congestion relief	

Note: the benefit of all end uses is not simply a sum of the benefits for each end use. In many cases, allocating some portion of an energy storage project to one end-use limits the ability of that portion of the energy storage project to satisfy any other end-use.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 5

ATTACHMENT A

CONSISTENT EVALUATION PROTOCOL SPREADSHEET

CONFIDENTIAL INFORMATION. Data provided to the CPUC herein is confidential under California Public Utilities Code Section 583, D.06-06-066, and D.13-10-040.
The Consistent Evaluation Protocol (CEP) is for energy storage benchmarking and general reporting purposes, per D.13-10-040.

		Offers:	1	2	3	4	5	6	7	8	9
Descriptive Items											
	IOU (PGE / SCE / SDGE)										
	Name of Shortlisted Project										
	Interconnection Voltage (kV)										
	Interconnection Level (Transmission / Distribution)										
	Local Capacity Area										
	Zone (NP / ZP / SP)										
	Status (New / Existing)										
	Product (Dispatchable / RA)										
	Energy Storage Technology										
	Commercial Operation Date										
	Term (Years)										
	Max Capacity (MW)										
	Min Capacity (MW)										
	Qualifying RA Capacity (MW)										
	Duration of Max Sustainable Discharge Rate (Hours)										
	Efficiency at Max Capacity (%)										
	Max Daily Switches -- Charge / Discharge (# Charges)										
	Max Cycles per Lifetime (# Cycles)										
	Self-Discharge in Stand-by (MW / Hour)										
	Ramp Rate -- Charge / Discharge, Up / Down (MW / Hour)										
	AGC (Yes / No)										
	Regulation at Zero (Yes/No)										
	Contract Cost ($)										
	Variable O&M for Discharging ($/MWh)										
	Fixed O&M ($/kW-Year)										
Quantitative Items*											
Market Benefits (CEP Assumptions)	Levelized Capacity RA Value ($/kW)										
	Levelized Energy Value ($/kW)										
	Levelized Ancillary Services Value ($/kW)										
	Distribution Investment Deferral Value - if applicable ($/kW)										
Market Costs (CEP Assumptions)	Levelized Capacity Payments and Fixed O&M Cost ($/kW)										
	Levelized Charging Costs and VOM Cost ($/kW)										
	Levelized Network Upgrade Cost ($/kW)										
	Levelized GHG Compliance Cost (if applicable) ($/kW)										
	Levelized Debt Equivalency Cost ($/kW)										
	Levelized Market Participation Costs ($/kW)										
NPV (CEP Assumptions)	Levelized Net Market Value $/kW										
NPV (Proprietary IOU Assumptions)	Levelized Net Market Value $/kW										
Applicable End Uses											
ISO / Market	Ancillary Services: Frequency Regulation										
	Ancillary Services: Spin / Non-Spin / Replacement Reserves										
	Ancillary Services: Ramp										
	Black Start										
	Real Time Energy Balancing										
	Energy Price Arbitrage										
	Resource Adequacy										
Generation	Intermittent Resource Integration: Wind (Ramp / Voltage Support)										
	Intermittent Resource Integration: PV (Time Shift, Voltage Sag, Rapid Demand Support)										
	Supply Firming										
Transmission / Distribution	Peak Shaving										
	Transmission Peak Capacity Support (Upgrade Deferral)										
	Transmission Operation (Short Duration Performance, Inertia, System Reliability)										
	Transmission Congestion Relief										
	Distribution Peak Capacity Support (Upgrade Deferral)										
	Distribution Operation (Voltage / VAR Support)										
Customer	Outage Mitigation: Micro-Grid										
	Time-of-Use (TOU) Energy Cost Management										
	Power Quality										
	Back-Up Power										

*With the exception of "NPV (Proprietary IOU Assumptions)" all of the Quantitative Items are calculated using standardized planning assumptions, as discussed in the CEP.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 6

RECOVERY OF ENERGY STORAGE COSTS

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 6
RECOVERY OF ENERGY STORAGE COSTS

TABLE OF CONTENTS

A. Introduction 6-1

B. Authorization for Cost Recovery 6-1

1. Transmission-Connected Domain 6-3

a. Transmission Asset for Reliability 6-3

b. Non-Generator Resource Providing a CAISO Market Function 6-4

2. Distribution-Connected Domain 6-4

a. Reliability 6-4

b. Non-Generator Resource Providing CAISO Market Function and Dual Use 6-5

3. Customer (Behind-the-Meter) Domain 6-6

C. Stranded Cost Recovery 6-6

D. Independent Evaluator 6-7

E. Conclusion 6-7

PACIFIC GAS AND ELECTRIC COMPANY
CHAPTER 6
RECOVERY OF ENERGY STORAGE COSTS

A. Introduction

The purpose of this testimony is to propose the ratemaking and cost recovery mechanisms that Pacific Gas and Electric Company's (PG&E) will utilize to recover costs associated with its procurement of energy storage pursuant to the California Public Utilities Commission's (CPUC or Commission) Decision 13-10-040 (Energy Storage Decision).

B. Authorization for Cost Recovery

The cost recovery discussion in this chapter is organized according to the framework presented in Table 1 of the Energy Storage Decision. PG&E intends to procure energy storage in the three storage grid domains: (1) transmission-connected; (2) distribution-connected; and (3) behind-the-meter, to achieve its 90 megawatt energy storage procurement target (Target) for the 2014-2015 procurement cycle. Energy Storage Decision, Table 1, shows that within each storage grid domain, storage performs a regulatory function, which is primarily either a generation/market function,[1] a transmission or distribution reliability function,[2] or a dual-use function as a facility providing both generation/ market and reliability functionality. The grid domain to which the facility is interconnected, in combination with the regulatory function, actual operation, and ownership by either a third-party or PG&E, will determine the appropriate ratemaking mechanism.

PG&E's assessment of the appropriate cost recovery and ratemaking mechanism begins with Table 6-1 below, in which PG&E has reproduced the sections of Energy Storage Decision Table 1 applicable to the energy storage proposed in this application. The form of cost recovery request for each type of

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1 In this case, the storage facility is a "Non-Generator Resource" as defined by the California Independent System Operator (CAISO) tariff, which states, "Non-Generator Resources"—Resources that operate as either Generation or Load and that can be dispatched to any operating level within their entire capacity range but are also constrained by a megawatt-hour limit to: (1) generate Energy, (2) curtail the consumption of Energy in the case of demand response, or (3) consume Energy.

2 Here, the storage facility functions as a "T&D Asset."

storage facility, PG&E's ratemaking mechanism or balancing account(s), and the rate component(s) that will recover the costs are provided in separate columns for the form of energy storage proposed in the application.

TABLE 6-1
PACIFIC GAS AND ELECTRIC COMPANY
COST RECOVERY BY STORAGE GRID DOMAIN

Storage Grid Domains	Regulatory Function	Ownership	Request	Balancing Account	Rate Component
Transmission-Connected	Generation/ Market	Utility-Owned	General Rate Case (GRC) or Application or Tier 3 Advice Letter	Utility-Owned Generation Balancing Account (UGBA) (Capital; operations and maintenance (O&M) expense) Energy Resource Recovery Account (ERRA) (Market Cost/Revenue)	Generation
		Third-Party	Application or Tier 3 Advice Letter	ERRA	Generation
	Transmission Reliability (FERC)	Utility-Owned	Federal Energy Regulatory Commission (FERC) Transmission Owner (TO) Rate Case	Transmission Access Charge (TAC)	Transmission
Distribution-Connected	Distribution Reliability	Utility-Owned	GRC or Application or Tier 3 Advice Letter	Distribution Revenue Adjustment Mechanism (DRAM) (Capital; O&M expense)	Distribution
	Generation/ Market	Utility-Owned	GRC or Application or Tier 3 Advice Letter	UGBA (Capital; O&M expense) ERRA (Market Cost/Revenue)	Generation
		Third-Party	Application or Tier 3 Advice Letter	ERRA	Generation
	Dual-Use (Reliability & Market)	Utility-Owned	GRC or Application or Tier 3 Advice Letter	Allocate based on usage DRAM (Capital; O&M expense) UGBA (Capital; O&M expense) ERRA (Market Cost/Revenue)	Distribution and Generation
Behind-the-Meter	Customer-Sited Storage	Utility-Owned or Customer-Owned	Utilize Existing Program-Specific Processes	Various	Distribution

While the cost recovery for all Non-Generator Resources is determined by the Commission, PG&E's cost recovery for transmission assets is approved by the FERC and by the Commission, in the case of a distribution asset.

For Non-Generator Resources, the ratemaking balancing account that would be utilized depends on whether storage is provided by a utility-owned facility or a

third-party purchase agreement. For facilities that provide dual-use functionality, the ratemaking or balancing accounts that PG&E expects to utilize would recover utility-owned generation (UOG)-related expenses through PG&E's ERRA and UGBA ratemaking accounts and distribution-related costs would be recovered through the DRAM. The relative allocation between these three accounts would be dependent on actual usage.

This dissection of the energy storage domain by function and usage aligns with the FERC recently issued Order 784, which established new accounting and reporting requirements for storage facilities under its Uniform System of Accounts (USOA). The new FERC USOA for storage facilities was implemented to better account for and report transactions associated with energy storage devices used in public utility operations. Aside from establishing new electric plant and associated O&M expense accounts by functional classifications—production, transmission, and distribution—for new storage assets, the USOA has protocols for recording costs in instances where an energy storage asset is used to perform more than one function or purpose. In these cases, entities are required to allocate the cost of the asset among the relevant energy storage plant accounts based on the functions performed by the assets.

PG&E will describe its proposed ratemaking terms with more specificity in the advice letter or application by which it seeks Commission or FERC approval for any particular energy storage procurement.

1. Transmission-Connected Domain

a. Transmission Asset for Reliability

PG&E proposes that transmission asset energy storage facilities that defer transmission-level infrastructure investment be utility-owned. PG&E will seek to collect the cost of such storage through the transmission rate by including the project's revenue requirement in its TO rate case filed with the FERC. The authorized TO revenue requirement will then be collected through the CAISO's TAC. Among other things, the TAC collects the annual authorized revenue requirement associated with the TO's facilities and entitlements which are turned over to the operational control of the CAISO by a participating TO, such as PG&E. The cost of energy storage from utility-owned

projects which are responsible for the deferral of transmission-level infrastructure costs will be included in the TAC.

b. Non-Generator Resource Providing a CAISO Market Function

PG&E may procure Non-Generator Resource energy storage that is owned by either a third party or a utility. For third-party or utility-owned storage projects, whether they are co-located or stand-alone storage projects, PG&E will seek to recover the cost of such storage through its generation rate by filing a separate application or including the request in the GRC, or in the case of utility-owned or third-party-owned storage facilities procured through the Energy Storage Request for Offer, by filing a Tier 3 advice letter. The revenue requirement associated with the capital and O&M expenses for utility-owned storage facilities will be recorded to PG&E's UGBA for recovery through the generation rate. Charges and credits for the operation of the facility in the CAISO market will similarly be included in PG&E's generation rate through PG&E's annual ERRA Forecast proceeding and costs will be recorded on an actual basis in ERRA. Third-party-owned storage facilities will be purchased through an Energy Sales Agreement (ESA) and costs associated with the ESA, and any CAISO market costs and credits associated with the operation of the third-party facility will be included in PG&E's generation rate through PG&E's annual ERRA Forecast proceeding and recorded on an actual basis to ERRA.

2. Distribution-Connected Domain

a. Reliability

If the energy storage device is a distribution asset that allows distribution infrastructure investments to be deferred, it must be utility-owned. PG&E would either include the project's revenue requirement as part of its GRC request, or request approval of the revenue requirement in a separate application or in a Tier 3 Advice Letter, as appropriate. Costs associated with that facility would be recovered through PG&E's distribution rate and recorded to the DRAM.

At this time, PG&E is not proposing to procure distribution asset storage service from a third-party-owned storage project. However,

third-party storage projects that support generation and market functions will be considered and are discussed below.

b. Non-Generator Resource Providing CAISO Market Function and Dual Use

A Non-Generator Resource that is connected on the distribution system can be utility-owned or owned by a third party. For either utility-owned or third-party storage projects in this category, PG&E will request to recover the cost of such storage through its generation rate in the appropriate Commission proceeding such as the GRC, in a separate application, or through a Tier 3 advice letter.

While either utility-owned or third-party storage facilities could operate as dual-usage facilities that support both reliability and market functions, PG&E will only consider utility-owned projects for the dual-use option. Third-party-owned storage facilities will not be considered for the dual-use cases.

Utility-owned storage that provides dual use functionality will have a component of its cost recovered through the distribution rate as well. As such, the expected allocation of costs for a utility-owned facility between distribution functionality and its generation functionality would be based on a forecast of its use. If PG&E procured a dual-use facility, it would submit its forecast allocation in the application or advice letter in which it submits its cost recovery request.

The revenue requirement associated with the capital and O&M expenses for utility-owned storage facilities will be recorded to PG&E's UGBA for recovery through the generation rate. Charges and credits for the operation of the facility in the CAISO market will be included in PG&E's annual ERRA Forecast proceeding and the costs will be recorded on an actual basis in ERRA and recovered through PG&E's generation rate. Third-party owned storage facilities will be purchased through an ESA; costs associated with the ESA, and any CAISO market costs and credits associated with the operation of the third-party facility, will be recorded to ERRA and recovered in PG&E's generation rate.

3. Customer (Behind-the-Meter) Domain

The Energy Storage Decision provides that behind-the-meter or customer-side storage targets may be fulfilled through existing programs such as the 2015 Demand Response (DR) Application, the distributed generation/ California Solar Initiative rulemaking, and alternative-fueled vehicle rulemaking. PG&E proposes to recover the cost of storage facilities procured through these existing programs through the cost recovery protocols established for these proceedings. For example, DR and distributed generation programs have established functionalized funding through the distribution rate. PG&E plans to utilize these existing funding sources to the degree those programs can meet the targets established for this program.

C. Stranded Cost Recovery

The procurement of market-based energy storage will meet the needs of today's bundled customers, but creates the possibility of stranded procurement costs due to the departure of customers for whom storage was procured. The Energy Storage Decision addressed the issue of potential stranded costs due to departing load by stating:

> [W]e remind [Energy Service Providers and Community Choice Aggregators] that, consistent with our prior decisions, departing load customers remain responsible for any costs associated with energy storage procured on their behalf at the time they were bundled service customers. (D.13-10-040, pp. 47-48.)

As discussed in the Energy Storage Decision, the cost of distribution assets will be recovered from departing load customers through the distribution rate structure.[3] Although not addressed directly by the Energy Storage Decision, the cost of any utility-owned transmission asset storage facilities that are recovered through CAISO's TAC rate would also be recovered from departing load (DL). However, the cost of Non-Generator Resources procured prior to customer

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[3] Decision 13-10-040, p. 47, "…customers of ESPs and CCAs will also pay for any energy storage systems procured for the IOU's distribution system as part of their distribution charges."

departure could become stranded and as such, will be included in the total portfolio indifference calculation authorized in Decision 08-09-012.[4]

Accordingly, contracts for such storage should be added to the portfolio of energy contracts for which DL is responsible, on a vintage basis, for recovery through the Power Charge Indifference Amount (PCIA). Current rules allow for recovery of conventional generation power purchase contracts through the PCIA for 10 years, or the life of the contract, whichever is less. Renewable contracts are recovered through the PCIA for the life of the contract. PG&E will seek authorization to recover the stranded costs of Non-Generator Resource procurement for the life of the contract or in the case of UOG, for the useful life of the project, when seeking Commission approval of such procurement.

D. Independent Evaluator

The Storage Decision requires each investor-owned utility (IOU) to retain an Independent Evaluator to evaluate the reasonableness of procured energy storage, and for the three IOUs to jointly fund a $500,000 budget fund to enable Commission staff to analyze and evaluate the implementation of the Storage Program. This budget will be funded beginning in 2015 and continuing through 2020, and is not to exceed $3.0 million dollars in total.

PG&E requests the Commission determine costs be allocated to each IOU based on their respective peak load of bundled customers, and that the cost be recovered through the ERRA.

E. Conclusion

PG&E requests that the Commission approve its cost recovery proposals for utility-owned and third-party storage facilities as outlined in Table 6-1 and described in this testimony. PG&E will provide more details regarding the specific ratemaking treatment being requested for any individual project at the time PG&E submits its request for approval of the project.

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[4] *Ibid.*, p. 48, footnote 103, "See, e.g., *Decision on Non-Bypassable Charges for New World Generation and Related Issues* (D.08-09-012)."

PACIFIC GAS AND ELECTRIC COMPANY

APPENDIX A

STATEMENTS OF QUALIFICATIONS

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF DONNA L. BARRY

Q 1 Please state your name and business address.

A 1 My name is Donna L. Barry, and my business address is Pacific Gas and Electric Company, 77 Beale Street, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a regulatory principal in the Energy Supply Proceedings Department, under the Vice President of Regulatory Proceedings and Rates. I am responsible for developing testimony and analysis to support proceedings filed at the California Public Utilities Commission on matters related to energy procurement and cost recovery.

Q 3 Please summarize your educational and professional background.

A 3 I received my bachelor of science degree in civil engineering from Washington State University and a master of business administration degree from Santa Clara University.

I began my career with PG&E in 1989 as an engineer in the Engineering and Construction Business Unit's Gas Construction Department managing gas distribution and pipeline replacement construction projects. From there, I took an assignment in the Gas Supply Business Unit in the Gas Engineering and Construction (GEC) Department as a project manager, managing three gas backbone transmission projects before joining the Gas Planning section in GEC where I analyzed the reliability of local transmission and distribution systems. I subsequently joined the Cost of Service section in the Rates Department where I performed cost of service studies and marginal cost analyses supporting various gas and electric rate applications. I joined the Electric Restructuring Cost Recovery section of the Revenue Requirements Department in 2001 and Electric Energy Revenue and Analysis and Ratemaking section in 2002. The department and section were renamed as the Energy Supply Proceedings Department in 2012.

Q 4 What is the purpose of your testimony?

A 4 I am sponsoring the following testimony in PG&E's 2014 Energy Storage Procurement Application:

- Chapter 6, "Recovery of Energy Storage Costs."

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF ANNA L. FOGLESONG

Q 1 Please state your name and business address.

A 1 My name is Anna L. Foglesong, and my business address is Pacific Gas and Electric Company, 77 Beale Street, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a manager in the Market Implementation Design and Strategy group in Energy Procurement at PG&E. I provide strategic support for commercial issues including procurement of storage, renewable, and conventional resources and link operational needs with market and planning requirements.

Q 3 Please summarize your educational and professional background.

A 3 I received a bachelor of arts degree in psychological and brain sciences from Dartmouth College in 2002. I received a master of business administration degree from the Tuck School of Business at Dartmouth in 2008. I have been employed by PG&E since 2010 and have held strategy and planning positions in Energy Procurement and Customer Energy Solutions.

Prior to PG&E, I worked in energy, economics, management, and climate change consulting at McKinsey & Company and Lexecon (now known as Compass Lexecon).

Q 4 What is the purpose of your testimony?

A 4 I am co-sponsoring the following testimony in PG&E's 2014 Energy Storage Procurement Application:

- Chapter 4, "Operational Requirements for Energy Storage Resources."

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF JAN GRYGIER

Q 1 Please state your name and business address.

A 1 My name is Jan Grygier, and my business address is Pacific Gas and Electric Company, 77 Beale Street, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a principal analyst in the Energy Policy Modeling and Analysis (EPMA) group of the Energy Procurement Department. I provide quantitative modeling and analytical support on policy and planning issues associated with utility owned generation, energy storage, and energy procurement, and I am one of the PG&E employees with responsibility for PG&E's calculations of costs and benefits of energy storage devices.

Q 3 Please summarize your educational and professional background.

A 3 I graduated from the University of Toronto, with a bachelor of science degree in 1978. I received a doctorate degree in environmental systems engineering from Cornell University, in Ithaca, New York, in 1983.

From 1987 to 1988, after a three-year post-doctoral fellowship at Cornell University, I worked on modeling, analysis and reports for environmental impact statements and other projects including the Super-conducting Supercollider for URS Consultants in Sacramento, California.

From 1988 to 1990, I worked as an operations research analyst and programmer at Synergo consulting in Ottawa, Ontario.

In 1990, I started work at PG&E in San Francisco as an independent contractor, in charge of hydrologic applications and modeling of the physical hydropower system in the stochastic mid-term SOCRATES hydro scheduling model. I was also lead developer of the Swift physically-based rainfall/runoff model.

I joined PG&E as an employee in 1997, initially as a senior operations research analyst in the Systems Engineering Group. I maintained responsibility for all flow forecasting and hydro scheduling models at PG&E, and later matrixed in to the Power Generation organization as Hydro Scheduling Consultant for the Mokelumne and Kings watersheds, where I

participated in negotiations with downstream water rights holders and provided strategic advice on operations and energy pricing of the Helms Pump Storage Plant (PSP). The experience with Helms PSP led to developing an operations and benefits model for PG&E's pilot sodium-sulphur battery in 2008.

In 2006-2010, I prepared analysis and testimony for Energy Resource Recovery Account filings, and presented tutorials on hydro forecasting and scheduling to the California Public Utility Commission's Division of Ratepayer Advocates.

After a nine month sabbatical, I joined the Energy Policy Planning and Analysis department as a principal in Greenhouse Gas (GHG) Market Readiness. I was responsible for assessing the design of California's GHG Cap and Trade market under Assembly Bill 32, and the readiness of the Air Resources Board and other compliance entities prior to and immediately following the launch of the market. As part of this effort, I led PG&E's analytical team and recruited multiple co-funding stakeholders for an experimental economics study of the GHG market.

With the GHG Cap and Trade market successfully launched in 2013, I provided support and modeling to PG&E's Energy Storage Request For Information, and became a prime architect of a new stochastic model of Renewable Portfolio Standard procurement.

Since transitioning to a principal position in EPMA in December 2013, I have worked on energy storage evaluation, drought-related hydro analysis, and a new mid-term hydro scheduling model being developed by Short-Term Electric Supply.

Q 4 What is the purpose of your testimony?

A 4 I am sponsoring the following testimony and workpapers in PG&E's 2014 Energy Storage Procurement Application:

- Chapter 5, "Evaluation Methodology."

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF GARRETT P. JEUNG

Q 1 Please state your name and business address.

A 1 My name is Garrett P. Jeung, and my business address is Pacific Gas and Electric Company, 77 Beale Street, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a senior director of Renewable Energy in Energy Procurement at PG&E.

Q 3 Please summarize your educational and professional background.

A 3 I received a bachelor of science degree in mechanical engineering and a master of business administration degree from the University of California, Berkeley. I have been employed by PG&E in Energy Procurement since 2003 as a director. I have been in my current position since 2010, and my job responsibilities include managing PG&E's Renewable Portfolio Standard portfolio. I have previously sponsored testimony at the California Public Utilities Commission.

Q 4 What is the purpose of your testimony?

A 4 I am sponsoring the following testimony in PG&E's 2014 Energy Storage Procurement Application:

- Chapter 1, "Overview and Policy."
- Chapter 2, "Report on Existing and Eligible Storage Resources."
- Chapter 3, "Intended Procurement of Energy Storage Resources."

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF STEVEN NG

Q 1 Please state your name and business address.

A 1 My name is Steven Ng, and my business address is Pacific Gas and Electric Company, 245 Market Street, Room 920A, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a principal electrical engineer in Electric Distribution Planning & Reliability Department of Electric Operations organization. I coordinate the effort within Electric Operations to implement the California Public Utilities Commission's (CPUC or Commission) energy storage decision. My key responsibilities include identification of potential Transmission and Distribution projects that could be deferred by energy storage systems, determination of the operational requirements of such energy storage systems, and review of the methodology by which the feasibility of such energy storage systems should be determined.

Q 3 Please summarize your educational and professional background.

A 3 I received my bachelor of science degree in electrical engineering from California Polytechnic State University, San Luis Obispo, California, in 1986. My concentration was in power systems. I also received my master of business administration degree in project and operations management from Golden Gate University, San Francisco, in 2002.

I have worked for PG&E for 27 years, or since 1986. My professional experience at PG&E includes electric distribution system planning, electrical system protection, substation engineering, electric transmission planning, renewable resource development, transmission operations engineering, and now, energy storage-related engineering and planning.

I began my career at PG&E in distribution planning and substation engineering, working in this capacity from 1986 to 1989. I spent the next 10 years from 1989 to 1999 in the system protection organization, performing and leading a group to perform protective relaying engineering studies and activities on PG&E's 60 kilovolt (kV) to 500 kV transmission and substation system.

From 1999 to 2004, I spent five years leading a transmission planning engineering group to coordinate and conduct generation interconnection studies for all new generation power plants that proposed to connect to PG&E's transmission system. Over 200 generation interconnection studies have been completed during my time there.

From 2004 to 2009, I returned to System Protection, where, as the manager, I led the provision of protection engineering services for the Company. I was responsible for the work of about 30 protection engineers in three different field offices. We were tasked with providing relay protection engineering services, including the unique remedial action schemes on our 500 kV system, various special protection schemes, protection design standards, and protection relay asset management.

From 2009 to 2013, I joined the Renewable Resource Development Department as the engineering manager for the development and implementation of PG&E's utility-owned renewable generation projects. During my five year tenure, the group completed nine photovoltaic projects, totaling 150 megawatts.

I have also engaged in a number of industrial trade groups related to renewable generation and have spoken at various conferences.

In the second half of 2013, I was asked to lead the Transmission Operations Engineering group for six months. I led a team of 22 operations engineers to provide real time electric transmission operations support for PG&E's 60 kV to 500 kV transmission system. The work includes coordination with many external organizations, such as California Independent System Operator, Western Electricity Coordinating Council, North American Energy Reliability Council, Federal Energy Regulatory Commission, municipal utilities, generators, and other neighboring utilities.

On January 1, 2014, I joined PG&E's Electric Distribution Planning & Reliability Department as principal electrical engineer to lead the effort within the Electric Operations organization to implement the CPUC's energy storage decision.

Q 4 What is the purpose of your testimony?

A 4 I am co-sponsoring the following testimony in PG&E's 2014 Energy Storage Procurement Application:

- Chapter 4, "Operational Requirements for Energy Storage Resources."

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.